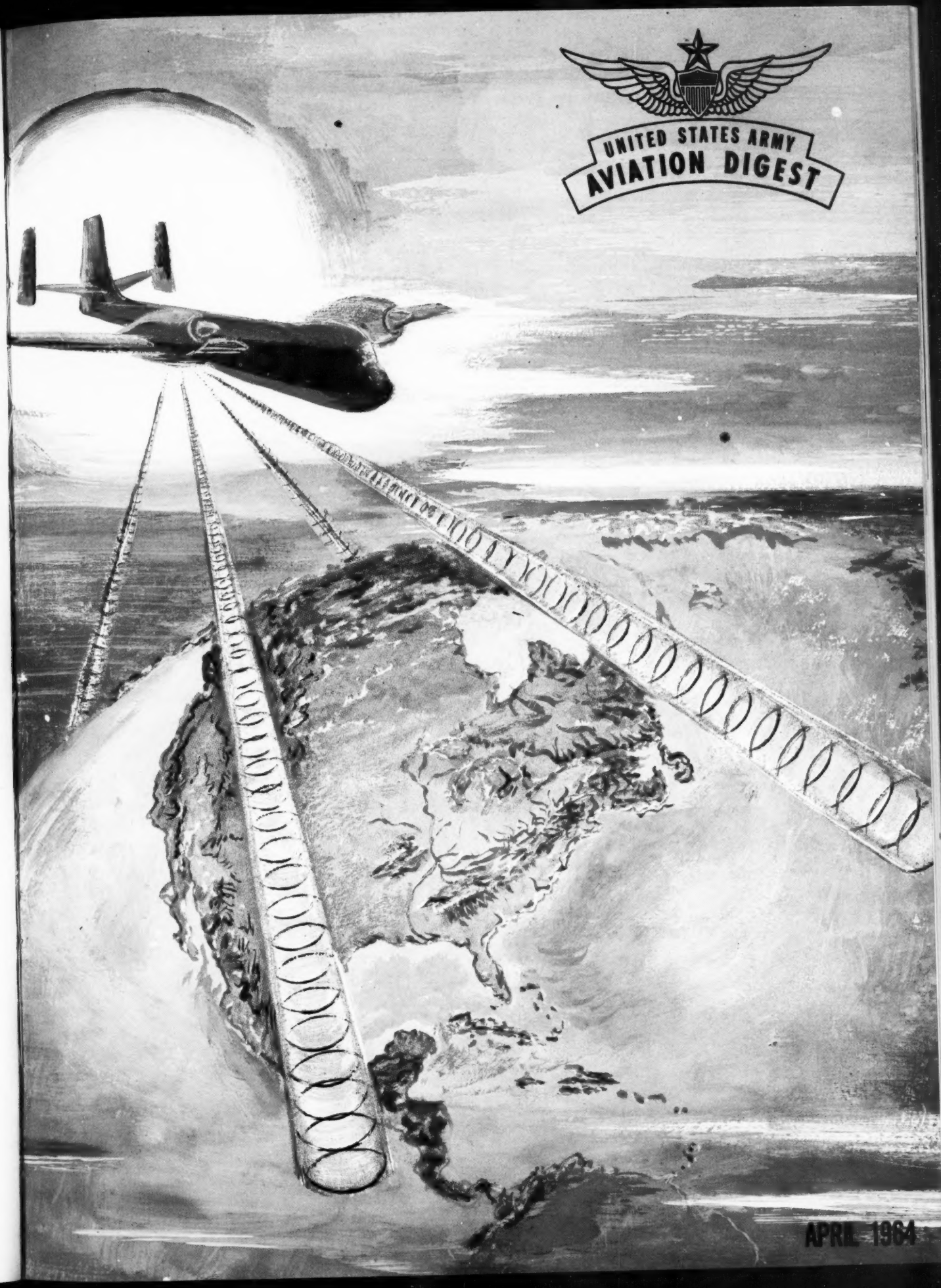
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AVIATION DIGEST
APRIL 1964

UNITED STATES ARMY AVIATION DIGEST

APRIL 1964 VOLUME 10 NUMBER 4

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The mission of the U. S. ARMY DIGEST is to provide information of an operational or functional nature concerning safety and aircraft accident prevention, training, maintenance, operations, research and development, aviation medicine, and other related data.

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Articles, photos, and items of interest on Army Aviation are invited. *Direct communication is authorized to: Editor-in-Chief, U. S. Army Aviation Digest, Fort Rucker Alabama.*

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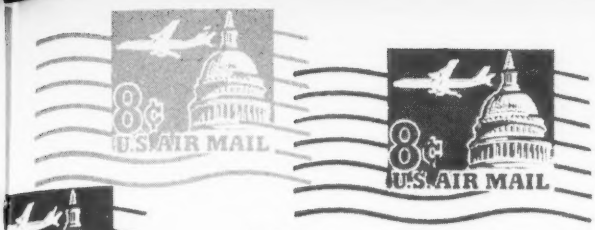


LETTERS

Sir:

Your interview in the January 1964 issue with Major Hertzog on cold injuries was interesting and informative. For the sake of completeness, I wish to point out that crew members and passengers who are seeking to *survive* after being forced down in a cold climate should have one additional piece of information.

Under survival conditions in a cold climate, if frozen feet occur, do not warm and thaw the affected parts. Frozen feet are still useful means of locomotion for performing survival operations. After rescue and return to a properly equipped medical facility, the doctor will rapidly thaw the feet. The patient has excellent prospects of minimal tissue loss even though two or three days may have elapsed since initial injury. The important fact to remember is that frozen extremities can still be used; thawed extremities mean the patient cannot walk and must be cared for as a litter casualty.

Further detailed information on the care and prevention of frostbite are to be found in the *New England Journal of Medicine* 266: 974-989 (May 10) 1962; and Mills, W. J., Jr., Whaley, R., and Fish, W., Frostbite: experience with rapid rewarming and ultrasonic therapy. *Alaska Med* 2: 1-3, March 1960. II. Ibid. 2: 114-122, December 1960. III. Ibid. 3: 28-36, June 1961.

LT COL RALPH C. SINGER
Chief Prev Med
APO 46, N. Y., N. Y.

Sir:

Congratulations to Major David Hughes on his recent letter to the editor concerning the Army Aviator [Jan. 64].

Finally, someone has gotten off the proverbial fence and has begun stating realistic facts. He describes the situation exactly, in that the Army Aviator may want to become a professional pilot but can't because he must pursue ground duties, increase his branch qualification, etc. Why? Because there is no realistic career program in Army Aviation. He finds higher promotion slots so limited in aviation that he must build a career in some other capacity.

Net result: as Major Hughes indicates, a half-baked pilot. The flight safety factor involved here is well known. I refer to a publication prepared by the University of Southern California, authorized by Air Force contract for Dept of Navy, Air Force and Army. It shows the accident rate one and a half times greater for military pilots whose primary duty is not devoted to full-time flying.

This fact was established in 1952 (at considerable costs to the taxpayer); yet we continue to operate in our present manner.

Why be half safe? Let the Army Aviator be a full-time professional pilot. At present we operate on the premise a professional soldier first and an amateur pilot second.

CAPTAIN WILLIAM R. HOLLIS
Mineral Wells, Texas

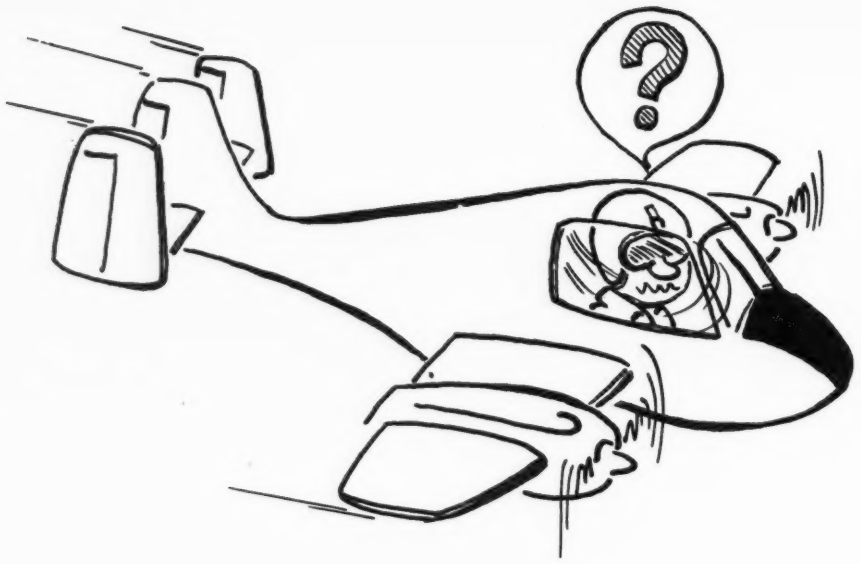
Sir:

I refer to the articles of Captain Dennison (Nov 63) and Major Hughes (Jan 64) which discussed the dual requirement for an Army Aviator to remain qualified in an airplane as well as in his branch of service.

I submit that the only substantial problem that exists here lies in the minds of the Army Aviators who do not want to shoulder the responsibility given to them in the form of a commission in the United States Army. Had we been commissioned as aviators, it would be a different thing. Instead, however, gold bars were pinned to our shoulders, a branch of service was assigned, and not one word was spoken or written about volunteering to fly, either part-time or exclusively. This was an individual choice, and once chosen it was made quite clear that there was no Army Air Corps anymore. Flying an airplane is, in effect, an additional duty for which we are paid extra money . . . .

Is the life of an Army Aviator so different from that of his counterpart in the other fields? Commanding an aviation company or battalion is just as demanding on the pilot as his counterpart in the infantry company or battalion. They both have command responsibilities, unit administration, staff work, courts & boards, CBR, ATT's, and what have you to function in. There is no double standard. They are both inspected by the same Inspector General. The officers under these aviation commanders still have the same responsibilities as most ground officers so far as additional duties are concerned. And let's face it, the majority of any officer's time is spent on these things which I've just mentioned, be he pilot or ground officer. So, are aviation officers really as short in their basic branches as some think they are? I don't think so.

Continued on page 48



DOPPLER—

"WELL ACE it seems that the old man just got reamed for that fiasco you pulled while flying the '3' yesterday."

Ace — Captain Jones — looked up at his old friend Capt Cy Thomas, who had just walked into the operations tent.

Captain Thomas continued, "You really did it when you couldn't locate the CP that Hornet 6 established. Hornet 6 was waiting to be briefed by the '3,' and you know how the Commander gets when his officers arrive late. Brother, you didn't even show! Now the old man is trying to figure out some way to make sure that when we jump off tomorrow we'll all fly to the correct objective through the established corridors. There aren't any prominent terrain features in this desert to navigate by. We have troubles. What's going to happen when we make a deep penetration into the desert?"

"Yeah, well Cy, the '3' made me fly on the deck, and with that wind you can't find 'em at all. I thought I had him cooled off though. I told him of our navigation problems and that if he could get the '4' to get us a Doppler navigator, we'd be in business. You know, all he did was give me a lecture on how he had to re-evaluate the available combat power.

"After the lecture, he asked me what a Doppler navigator was. I told him all I knew and he said we'd go see the '4' right away and get us some Dopplers so he could get back his lost combat power."

●●●

A major problem confronting today's Army Aviator is his inability to navigate with precision over unfamiliar areas. A degree of combat power that should be available to the commander is, therefore, lost because of the pilot's inability to provide an effective response to the commander's needs. The total combat power of a unit is effective only when individuals can provide a timely response to the commander's needs and can capitalize on a situation.

The Army Aviator presently navigates by the pilotage method and by electronic aids.

Navigation by pilotage requires good judgment and almost constant attention and alertness by the pilot to navigation details. The pilot is not

Maj Vaughn is project officer, Flight Systems Branch, Avionics Division, U. S. Army Aviation Test Board, Ft Rucker, Ala.

totally effective to tactical needs since his attention must be divided between the tactical requirements and navigation details. Navigation by pilotage at night is especially difficult and cannot be accomplished to any acceptable degree.

Electronic aids can be divided into two categories:

One category of electronic aids is a ground station used with airborne receivers to provide position to the pilot. Survivability then becomes a problem in a hostile airspace, since the pilot is unable to "hide" within the nap of the earth and still obtain navigation position information from a distant ground station.

The second category is a self-contained airborne navigation (SCAN) system where the navigational information is generated totally within the airplane. The airborne Doppler navigator falls within this category.

U. S. Army Aviation Test Board personnel have conducted tests on a number of Doppler navigation systems. The latest test was a comparative evaluation between three commercially available off-the-shelf systems. This evaluation was conducted to provide a basis for selecting one of the systems for Army use.

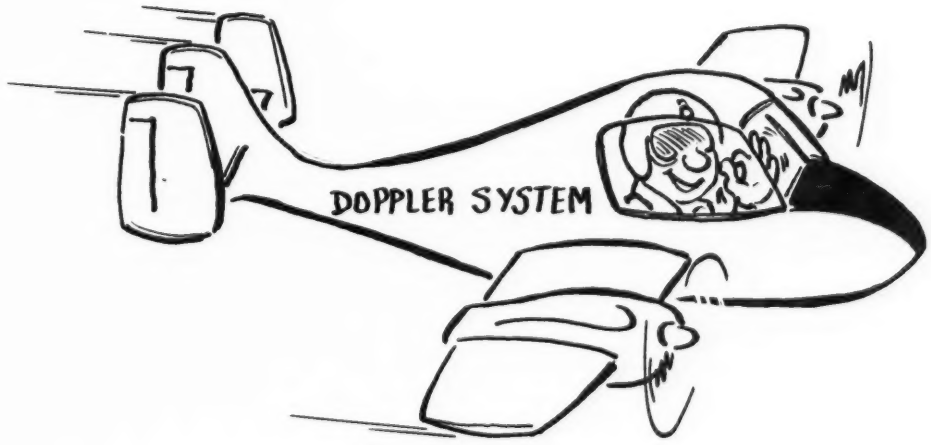
Doppler navigators come in various sizes and weights, and they can provide various capabilities. An average Doppler navigator weighs about 100 pounds and is packaged in approximately nine various sized boxes.

The pilot using a Doppler can navigate without reference to ground-based navigational aids or without visual reference to terrain features. The Doppler principle or Doppler shift effect is the apparent change in frequency caused by a moving object in relation to another object, either fixed or mobile. The frequency change (pitch) noted when a car or train passes with its horn blowing is an example of the Doppler effect.

In the Doppler system, microwave energy is radiated to the ground in multiple beams and is reflected back to the aircraft. By detecting the amount of Doppler shift of the reflected signals, the velocity vectors of the aircraft are determined and fed into a com-

R—Asset or Liability?

Major James Vaughn



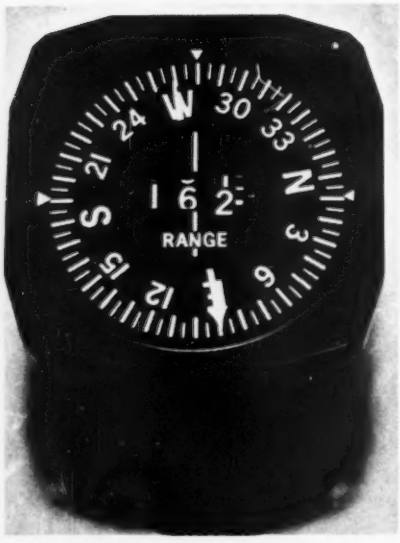


Figure 1

puter together with the heading from the aircraft compass system. The computer outputs are then used to drive the navigational displays for the pilot.

The outputs which the Doppler navigator provides the pilot consist of groundspeed and track, present position data, and bearing and distance to the selected destination. With this information, a pilot can fly to his destination by the most practical route with minimum delay.

Two basic types of navigational displays are provided for use by the pilot: the bearing distance indicator which is available in various configurations (fig. 1, 2, and 3) and the navigation pictorial plotting board (fig. 4).

The bearing distance indicator (BDI), as its name implies, provides steering and range information to a preselected destination. This information can only be obtained by programing the navigation computer with the proper data (location of aircraft and destination). The operation of the BDI closely parallels the present ADF needle in its function and it also gives distance-to-go to destination.

The pictorial navigation display board does not require the computer to be programed. The reticle which symbolizes the aircraft's position is slewed to the aircraft's position on the chart (coordinates) before takeoff. After takeoff it can also be positioned over a known point as the aircraft flies over that point. The reticle will move over the chart corresponding to the flight path of the aircraft. Updating may be necessary to correct for errors

Figure 2

introduced by the use of inaccurate maps and inaccurate heading reference systems.

Doppler systems, to include the aircraft heading reference systems, will provide present position, bearing, and distance accuracies between 1 and 2 percent of the distance flown. Accuracy can be effectively increased if the system can be relied upon to consistently repeat all errors at the same rate at a given position. A pilot can then compensate the system after he has flown in an area for some time and knows beforehand that he will have to apply some "Kentucky windage" to the flight path.

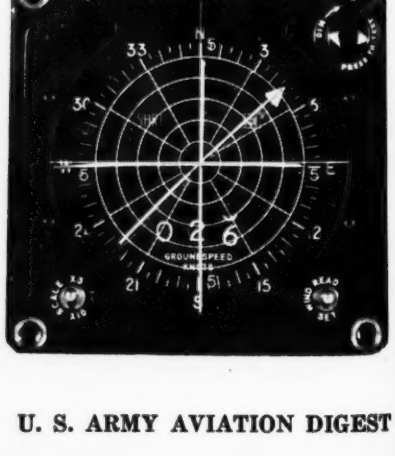
A brief look at the support requirements is necessary to understand the liability side of the Doppler navigators. Failure to understand the operation of a Doppler system or to fully meet the needs of any one of the following major support areas will result in a degradation of the system's performance.

● *Personnel training.* Both operator training and maintenance training will be required. The training for the maintenance personnel will, of course, depend upon the echelon of repair. Organizational maintenance will be limited because of the complexity of a Doppler system.

Operator training should consist of a thorough familiarization with the operation of the equipment and with navigational principles and techniques for all latitude operation. In addition, the operator must know how to prepare and use Doppler charts (they may be used in lieu of maps) and how to compute the data to be used to program the navigation computer.

● *Compass calibration.* Equipment is not presently available to all Army units to

Figure 3



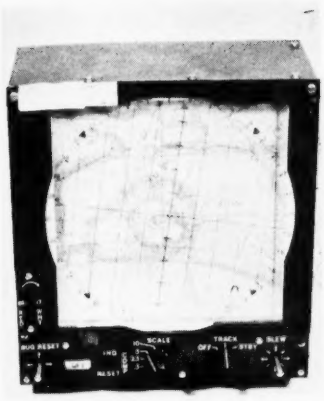


Figure 4

permit calibration of compasses to the required accuracy. A deviation of ¼ to ½ degree can be expected when adequate care has been exercised during compass system installation and compass compensation. An error in excess of this amount is unacceptable for use with a Doppler system.

● *Maps.* Two scales of maps should be provided to the pilot to permit him to successfully complete a mission. One scale is needed for en route navigation and the second one is needed for the terminal area. A timely and adequate distribution must be available, since the use of the Doppler system is dependent usually upon measurements obtained from a map. In addition, the Pictorial Navigation Display requires four identical maps or charts to provide complete area coverage for the necessary map overlap for one aircraft.

"Doppler charts" may be constructed after sufficient flights in an area have been completed to permit geographical locations to be plotted based on "Doppler destination." Doppler charts may be of particular significance if a timely and adequate distribution of maps is not available. The use of Doppler charts will also be of value to up-date grossly inaccurate maps.

It can readily be seen that the effective combat power of a tactical unit can be increased by employing Doppler navigation. However, adequate support facilities must be available and Doppler trained personnel must be used. Both the support and personnel requirements are unit problems. The Doppler system will become a unit liability if support and personnel requirements are not met.

UH-1B Tops 175 Knots

A BELL research UH-1B helicopter has been flown 210 mph — more than 50 mph faster than the world's record for its weight class.

The research UH-1B was modified by adding two Continental J69 auxiliary jet engines to the fuselage. With the ship well above normal gross weight, the 210 mph speed was achieved with only 780 hp of the helicopter's 1,100 hp Lycoming T53 engine, plus 1,210 pounds of thrust from the J69 auxiliary engines.

The total equivalent power of this combination was below 1,500 hp. During the flight an advancing rotor blade tip approached the speed of sound, achieving mach .95.

The flight research helicopter is equipped with standard 44-foot UH-1B rotor, engine, and other dynamic components. Future work will include testing with fixed wings and the jet engine in combination on the research vehicle.

Objective of the high-performance helicopter test program is to increase the helicopter's mission and cost effectiveness. Bell is conducting this test program under contract with the U. S. Army Transportation Research Command, Fort Eustus, Va.

. . . this ability to navigate from any type of map rightfully belongs to the Army Aviator. It is his

STOCK IN TRADE

Lieutenant Colonel Robert L. Cody

TODAY I WAS reminded of a most important aspect of our mission as Army Aviators. It is not a new problem, but one which we must constantly reaffirm and vitalize: the ability of Army Aviators to function effectively in the field without sophisticated aids.

The officer who broached the subject is an Artillery colonel who, while not rated, is highly knowledgeable in the Army Aviation field and is a great proponent of its capabilities. He recounted an experience which had revealed to him the fact that we Army Aviators are, in many cases, really missing the boat.

During Exercise SWIFT STRIKE III this officer needed to visit the headquarters of one of the participating tactical units. He arranged to be flown in an OH-13 piloted by a young officer flying in support of the Joint Control Center at Spartanburg, S. C. After comparing notes on the reported location of the command post, the two took off. The pilot had a sectional chart nonchalantly draped over his knees, and the colonel grimly clutched his 1:50,000 terrain map in his slightly sweaty hand.

The flight plan called for a fairly low altitude throughout the flight, principally to avoid the stream of large aircraft operating in the ALOC. Almost as the airport was lost to sight, the stalwart young aviator lost his orientation and the colonel assumed the duty of navigator — quite successfully. Obviously, the sectional chart was not the right aid for this flight and the pilot was not accustomed to, or had lost his touch for, the terrain map.

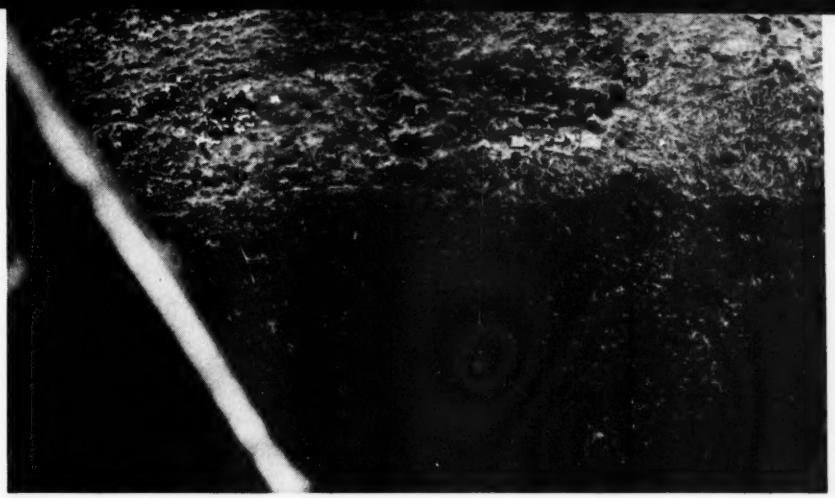
The colonel rightly pointed out that our real value lies in the intimate association of our aviators and their aircraft with the ground elements we support. We can support effectively because we know and understand the organization, tactics, doctrine, techniques, and problems of the units we serve. No other agency can do this.

We must be able to use the same tools as the ground elements, whether they be communication systems or maps. But we must have the tools. Commanders must ensure that adequate tactical maps are made available to aviators. One aviator tells of a previous SWIFT STRIKE maneuver during which pilots were expected to fly support missions with a sectional chart and a black and white print of a tactical map issued on the basis of three per aviation unit.

The colonel further expressed his personal belief that the

Col Cody is serving in the J-5 office, USSTRICOM, MacDill AFB, Fla.

current trend in Army Aviation toward greater sophistication militates against our ability to maintain this close, responsive association with ground units. We tend to justify such things as more and better radio navigational equipment, airborne radar, and UHF communications on improved all-weather capabilities. To a considerable degree this is true. However, these luxuries tend to make us lazy, and we lose our touch for contact flying at low level in marginal weather. For most of us it has become a lot easier to cruise at 8,500 along the airway on a VFR hop rather than practice pilotage techniques at 1,500 absolute. How often on a cross-country do we set aside the sectional or avigation charts and navigate from a copy of the pride of the Army Map Service? Not often, I'm afraid.



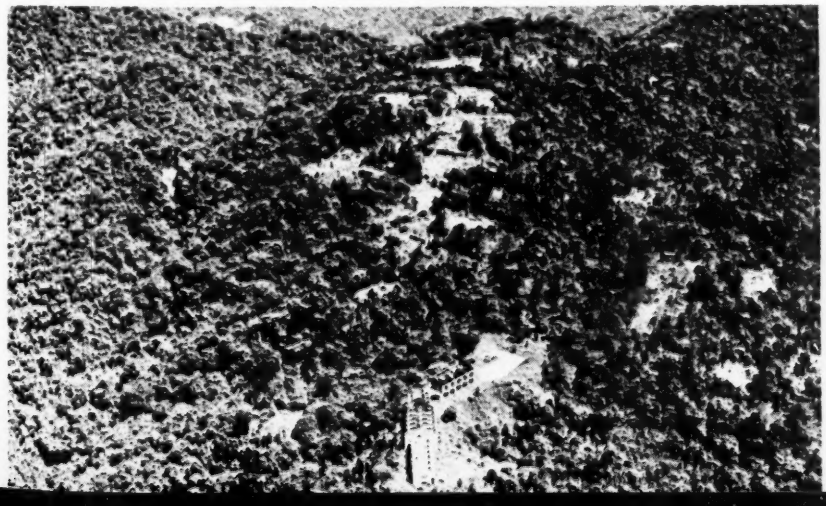
Is your pilotage sharp enough for you to find an outpost in terrain like this? Your next assignment may call for top professional navigational ability. Are you up to snuff?

Our operational units in the Republic of Vietnam are flying all types of Army aircraft under extremely primitive conditions and doing it very effectively. It could be said that our pilots can wait until they are assigned to units there to sharpen up their contact navigation techniques. But what about the time delay before they are sharp enough to operate on their own, to say nothing of the added burden on the old hands of shaping up the newcomers? Wouldn't it be much better to have the basic ability on arrival, leaving only the requirement for a relatively simple local checkout? Put yourself in the position of the aviation unit commander and see what answers you come up with.

Try this little exercise some time soon. Pick an arbitrary course from your home field and fly it for at least an hour at the lowest safe, permissible altitude. Preferably it should be toward an unfamiliar area. Keep your eyes open for other aircraft, but pay no attention to the ground or winddrift. At the end of the predetermined time, get out your terrain map and orbit until you have positively located your position. Pick a new heading for the base leg of a triangular course and repeat the process. At the second position plot your course for return to home base. Fly the third leg to check accuracy of your plot and choice of checkpoints. To some this will be no trick at all; to others, not so easy.

The colonel's remarks seemed to indicate that most of us are enjoying this move toward sophistication, a sort of step-up to a higher strata of aviation society. No one can logically argue against any improvement in operational capabilities; however, the young helicopter pilot's experience indicates that improved technology sometimes leads us away from our ability to operate in the primitive environment that probably will prevail in any battlefield of the future. Our goal must be to operate at full scale under minimum conditions of visibility. Technology probably will never give us this capability, so we must rely on good old-fashioned pilotage. After all, this ability to navigate from any type of map rightfully belongs to the Army Aviator. It is his stock in trade.

Complete reliance on a sectional chart to guide you to a confined area such as this is nonsense. Learn to use every type of navaid to accomplish your mission.



Scratch

IN MARCH 1958 an Army Aviator attempted a 333-mile flight in a U-6A aircraft heavily loaded with electronics equipment. Immediately upon breaking ground the aircraft assumed an extreme, nose-high attitude. Full forward elevator and forward trim only slightly corrected the dangerous attitude.

The aviator found that by reducing the power the nose would come down, but then the plane ceased to climb and started to descend. Full power corrected this situation, but the aircraft again assumed a dangerous nose-high attitude. The slightest amount of bank caused a partial stall and loss of altitude. At an altitude of approximately 200 feet, the aircraft stalled and the aviator lost control. It spun in and crashed into some trees off the end of the runway. The aviator escaped with only minor injuries, but the aircraft and its contents were damaged beyond repair.

Investigation proved that the U-6 was loaded 500 pounds over maximum gross weight, and the center of gravity was 14 inches aft of the aft limit for maximum gross weight. This accident could easily have been prevented if the aviator had only taken the time to check and see if this aircraft was loaded within safe flying limits.

With the advancement of aviation and the procurement of larger cargo type aircraft, weight and balance factors become more and more critical.

AR 95-16 divides all Army aircraft into two classes. In Class I are those aircraft which cannot readily be improperly loaded. Class II aircraft are those with center of gravity limits which can readily be exceeded by improper loading arrangements. The AR further stipulates that all Class II aircraft shall have a 365F form (Weight and Balance) filled out in duplicate copy before each flight. One copy is filed with the flight plan and the other remains with the aircraft. This form is good for 90 days and then destroyed or redated.

Instructions on how to fill out the 365 forms is covered in TM 55-405-9, dated February 1962.

This TM includes information on: (1) principles of weight and balance, (2) weight and balance records, including instructions for use of charts and forms, (3) weighing of aircraft and weighing equipment, and (4) aircraft loading data. The -10 and -20 along with TM 55-405-9 should be used when specific weight and balance data is required for a particular aircraft. The TM 55-405-9 contains material that applies to all activities that operate and/or maintain Department of the Army aircraft.

RESPONSIBILITIES

Aircraft manufacturers are responsible for furnishing basic weight and balance data for every aircraft delivered to the Army. Once the aircraft are delivered, however, it becomes the responsibility of maintenance and operating units to maintain accurate weight and balance data. Field maintenance activities are required to weigh aircraft periodically to ensure that basic weight and balance data is accurate. The *pilot* is responsible for ensuring that the gross weight and balance conditions of his loaded aircraft are within safe limits.

The Office, Chief of Transportation will be responsible for weight and balance engineering training necessary

Lt Holt is with the Fixed Wing Branch, Advanced Maintenance Division, Department of Maintenance, USAAVNS, Ft Rucker, Ala.

to provide weight and balance services at direct support, general support, and depot support maintenance facilities. Direct support field maintenance activities will be responsible for arrangements with general or depot support activities to weigh aircraft on a cross-service basis by other Department of Defense services, or by contractual agreement, in the event equipment and personnel are not available at the direct support shops. All Class II aircraft must be weighed once a year or as often as deemed necessary to ensure that weight and balance data is accurate. In Class I aircraft, at least one aircraft of each type shall be weighed annually. This basic weight and moment is then entered on the 365C form (Basic Weight and Balance Record) which is sometimes called the chart C.

Since the changeover from TO 1-1B-40 to TM 55-405-9 a number of questions still arise concerning these publications. Listed below are some of these questions and the answers that may be of benefit in computing weight and balance data.

1. In computing weight and balance, Form 365F and conflicting information is found between the TM 55-405-9 and appropriate manuals for a particular aircraft. Which publication should be used?

In the event of conflicting data between the -9 and aircraft manuals, the appropriate manuals for the aircraft should be followed.

2. Recent (-10) manuals contain DD Forms 365A and 365C, but none of the manuals of the TM 55 series contains the DD Form 365B. Where will this form be maintained?

In the future TM 55 series, aircraft maintenance manuals will not contain DD Forms 365A, B and C. They will be processed in accordance with TM 55-405-9 and will be maintained in the aircraft publication file of each aircraft.

3. Will Appendix IV of the (-20) organizational maintenance manuals for all aircraft contain the same information as Appendix IV of TM 55-1520-204-20?

Appendix IV is being discontinued in the individual aircraft -20 manuals. In lieu thereof, the -20 will contain a reference to TM 55-405-9. Applicable loading data will also be included. Peculiar data relative to a specific type, model, and series of aircraft will be reflected on DD Forms 365A, B and C.

4. Are weighing instructions required in the Appendix IV of the (-20) organizational maintenance manual when AR 95-16 assigns the responsibility for aircraft weighing to field maintenance activities?

The answer to question number 3 also applies in this case. The assignment of responsibilities for weighing of aircraft will be in consonance with AR 95-16.

5. Where can extra 365 forms be procured on exhaustion of the present supply?

They can be requested through normal requisition channels.

6. Does a 365F form ever become classified? If so, when?

The 365F form becomes classified when classified components are entered on the 365F form for weight and balance computation. This form should then be handled as all other classified material.

A review of the TM 55-405-9, and the -10, and -20 for the aircraft in which he is qualified should reduce to zero the number of Army Aviators who are unable to correctly fill out and compute a simple weight and balance problem of any load on any aircraft!

. . . or Scrap

Lieutenant Robert T. Holt

watch how they jack up that jack, Jack!

Captain Robert B. Kenyon

HOW MANY TIMES have you observed an aircraft mechanic energetically pumping the handle of a hydraulic jack to lift his bird from the ground, completely oblivious of the fact that the wings were securely tied to the ramp, or the wheels were not chocked, the brakes unlocked, and so on ad infinitum?

Make you grit your teeth? Or turn your head in the other direction? Very few individuals enjoy criticism, even though constructive, but a few well chosen words at this time might possibly have saved a crew-chief much embarrassment, the Army a considerable sum of money, and a human life.

Perhaps the one quality, or lack of it, which contributes most to an accident involving the jack is common sense. A few individuals completely forget or ignore the basic law of gravity the moment their hands close around a jack handle. They "place and pump" with reckless abandon, remove a wheel, and then walk off to find the bearing grease—leaving their crippled bird precariously perched on two good gears and a "crutch." Not that anyone would purposely kick the crutch from under an invalid machine, but a sudden gust of wind, an unsuspecting nudge from a passing transient, or prop and/or rotor wash could do just that.

And don't for a minute disregard the possibility of a defective jack. The investigation report of a recent ground handling accident involving a U-6A might possibly list a 5-ton hydraulic jack as one of the culprits. A small spring-loaded brass pin intended to prevent the screw portion of the jack from becoming inadvertently disassembled was missing. This enabled someone to unscrew it to where only a fraction of one thread was still engaged. It appears that this, combined with poor supervision, resulted in an estimated $1,000 loss to

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Capt Kenyon is with the Instrument Support Division, Department of Maintenance, USAAVNS, Ft Rucker, Ala.

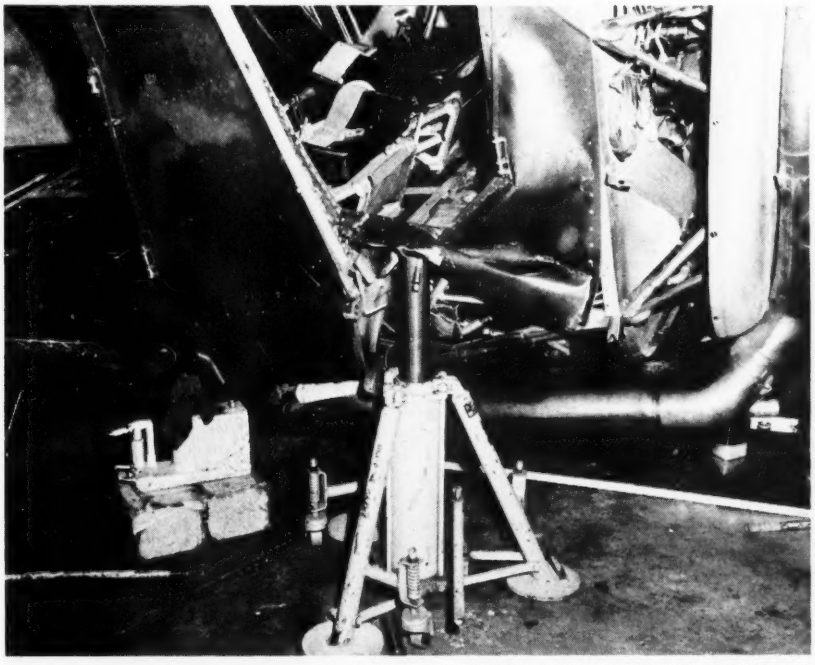
the government when the U bird "fell" from the jack and impaled itself on the lower two-thirds of the jack. (See photo.)

What can we do to prevent this needless loss of equipment and potential hazard to life and limb? As in every other field of military endeavor, on-the-spot correction is one of the oldest and most effective means of rectifying a dangerous situation. This personal attention, coordinated with a program of safety education (a supervisory function), can do much to eliminate reports of investigation and reports of accidents.

We are fully aware of the positive approach to a problem, but in this instance we feel that a few negatives should be included in any applied program of equipment operation safety. The more salient points to emphasize are:

- Aircraft will not be supported by jacks any longer than the minimum time it takes to accomplish the required maintenance. For example, when it becomes necessary to replace a wheel, the aircraft will not be jacked up and the wheel removed until the replacement wheel is physically present and ready for installation.
- Under no circumstances will an aircraft be supported by jacks without secondary supporting devices (dollies, chain hoist, fork lift with padded forks, etc.) being used to prevent loss of life or equipment if the jack should fail.
- Any jack suspected of being defective will be immediately turned in to the appropriate maintenance organization for inspection and repair.
- Jacks will not be extended to the point where the possibility exists of components becoming separated.
- When it becomes necessary to support an aircraft on a jack or jacks, all wheels will be securely chocked, brakes will be locked if commensurate with the maintenance to be performed, and caster tail wheels will be straight and chocked and/or locked to prevent swiveling.
- Care will be taken to place the base of the jack so the shaft will be vertical (directly under the supporting point) after extension.
- Personnel will not enter the aircraft while it is in any way supported by jacks unless it is necessary to perform the required maintenance (as in retraction tests).
- Precautions will be taken to notify unsuspecting personnel when an aircraft is being supported by jacks (area roped off, caution signs displayed around the aircraft, etc.).

Admittedly, this program cannot guarantee that accidents involving the use of jacks will not occur, but we'll be willing to bet a gold plated jack handle that it will reduce the incidence rate.



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Viet Cong Roundup

"THERE IS A very real war going on in the Republic of Vietnam in which a soldier can get killed just as dead as in the Normandy invasion. . . ."

So spoke Army Chief of Staff General Earle G. Wheeler just after he visited Vietnam.

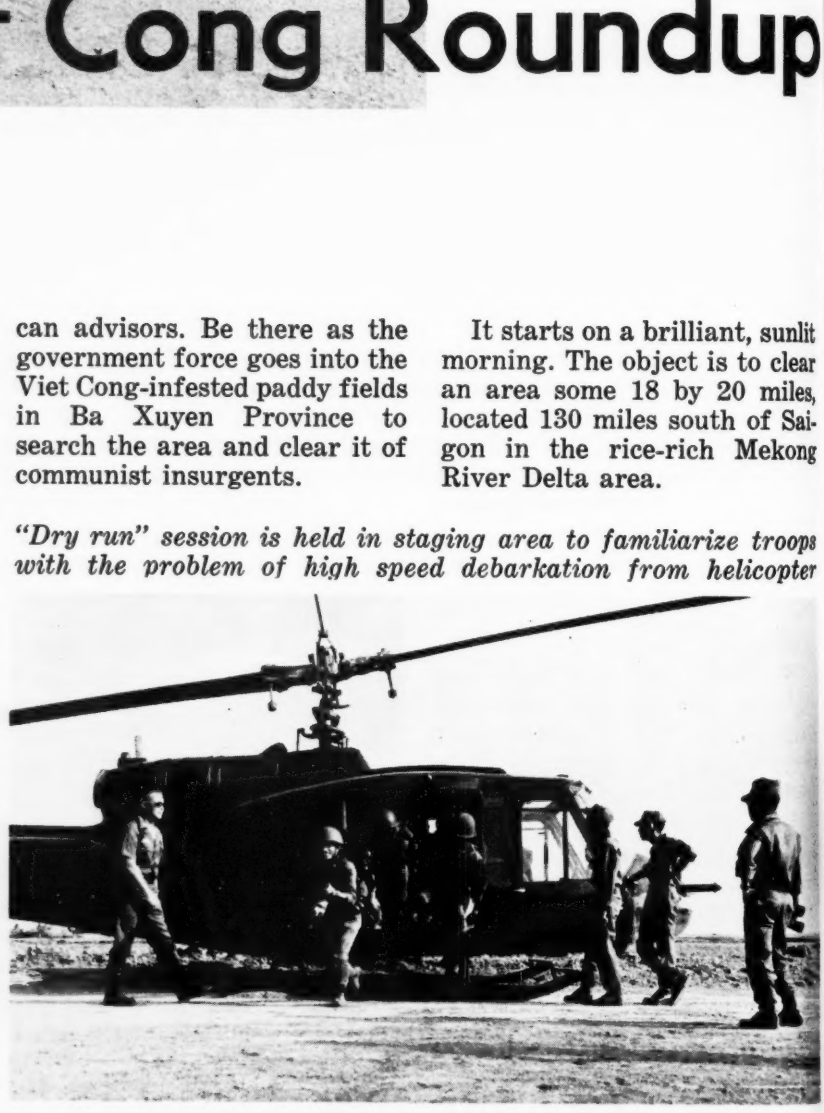
But if he is an advisor, why does the American soldier carry personal small arms? If he is an advisor, why does he get close enough to get shot at by the communist Viet Cong forces, and sometimes wounded or even killed?

The answer to these questions can be summed up in a simple statement: one cannot advise from an office in Saigon; the advisor must be on the ground, with his counterpart, to do his job, and he's armed so he can defend himself if the occasion demands.

Come along on an operation with a force of Vietnamese Army troops and their American advisors. Be there as the government force goes into the Viet Cong-infested paddy fields in Ba Xuyen Province to search the area and clear it of communist insurgents.

It starts on a brilliant, sunlit morning. The object is to clear an area some 18 by 20 miles, located 130 miles south of Saigon in the rice-rich Mekong River Delta area.

"Dry run" session is held in staging area to familiarize troops with the problem of high speed debarkation from helicopter



A large scale operation, it will involve 600 men as well as tactical air support for ground strikes when needed, and helicopters to provide mobility for the troops.

One can't be everywhere on a mission of this magnitude, so let us join a commander of the 21st Reconnaissance Company, and a U. S. military advisor who is working with him on this operation.

They carefully review the plans, go over the map, and prepare to jump off.

The troops, in long lines, silhouetted against the early morning sky, are ready to board helicopters. Seemingly from nowhere the Hueys drop to earth, their rotors whacking sharply in the morning silence. Quickly the troops are aboard the UH-1s, and just as quickly the choppers soar skyward again. It is not healthy to keep a helicopter on the ground in Vietnam, for they are an inviting target for Viet Cong ground fire. This phase of the operation is known as "Eagle Flight"; the air assault troops do not enter the fray unless action is imminent.

Now comes the search. Nine helicopters are in the formation: four carrying troops, and five armed choppers for escort. They orbit the target area, scanning the ground intently, seeking VC activity.

Suddenly, a report of suspicious activity in a small village sends the troop carriers fluttering to the ground. Eagle Flight squads rush to the target and begin the search.

Meanwhile, small groups of Viet Cong attempting to escape across the paddies are being chased down. Struggling to free themselves from their captors, they are dragged aboard helicopters by the Eagle Flight troops as armed choppers stand by, ready to come to the defense of their more vulnerable sisters. In moments the choppers are off again, seeking more Viet Cong.

Elsewhere, ground troops are clearing the densely foliated areas along the canals, from clearing to clearing, from village to village. It is an operation of painstaking thoroughness. Each hut in each village must be searched for Viet Cong or for their hidden weapons.

UH-1B, bristling with rockets and machineguns, searches rice fields for VC fleeing from burning stronghold

But the search must be made cautiously, for a VC weapon, or even a flag, found in a hut could be, and often is, a booby trap ready to blow the searcher to eternity.

The combat operation goes

Vietnamese troops and their American advisor move into a suspected VC hideout

Gunner on escort helicopter scans area while Vietnamese troops from sister ship drag VC prisoner from rice field

on for two days. Sometimes there are air strikes when a target is spotted. Most of the time it involves dashing into areas at breakneck speed, trying to apprehend fleeing Viet Cong.

Sometimes the VC will fight, but now he is scattered and disorganized, and only the hard core fanatics will engage in combat.

Two days after it began, the operation is over, and the final score:

Friendy losses: none.

Viet Cong losses: 14 killed, 7 captured, and 22 suspected VC captured. Several Viet Cong structures lay in ruins, and three of their sampans were destroyed.

Somewhere during the operation, a Vietnamese government official has been released from VC capture, and five hand grenades and one homemade VC rifle have been taken by friendly forces.

Two days of swift strikes, flushing, chasing, searching, and the communist VC is deprived of another area of operations. It's an operation, a variation on a theme, much like hundreds throughout the country every week.

It's the kind of antiguerrilla warfare that is playing a large part in winning the war against insurgent communists in the Republic of Vietnam.

Prisoners brought in from battle area by helicopter assemble under watchful eyes before moving to interrogation area

Reserve troops sweat it out, awaiting call to bring them into action. They were not needed.

Army Aviators on routine missions for IAGS still can fly in the

Lurches of the Unknown

Captain Frank A. Mariano

THE DAY WAS HOT, humid—a normal day during the rainy season on the north coast of Honduras. Flying in this tropical country on a mission for the Inter-American Geodetic Survey through the months of rain, heat, rain, humidity, and more rain lessens the number of surprises and dangers remaining in a man's life. This day was no exception.

Aboard my trusty Iroquois, at an altitude of 5,000 feet above sea level, was a geodetic engineer whom I was transporting, along with survey gear, to a picture point located in a valley. The area resembled many into which we had previously flown, although I did notice a small cultivated area on a river bank which was overhung with tropical plants and trees. On second thought, however, this didn't seem too unusual since many of our survey points were amidst jungle areas canopied with banana trees.

The engineer indicated by pointing that he wanted to land in the small cultivated area; it was a picture point vital to his closure plans. I made a low recon of the area and elected to go in. After a normal approach, I proceeded to shut down the aircraft. Except for the wheezing of the rotor blades cutting the dense wet air, there was nothing to be heard. Momentarily, while waiting for the blades to stop, I suspected movement behind one of the trees ahead of the helicopter but cast it off as an animal of some type, a typical scene in the jungle. For some reason I was glad that my .45 cal pistol and machete were close at hand.

Suddenly, out from behind the tree darted a man, or at least he looked like one. I peered at him, then turned to the engineer, who had also seen the action taking place to the front. He returned a look which I'm certain I also wore on my face. This man was a sight to behold. There he stood, not more than 20 yards away, wearing nothing but a loin cloth made of animal skin and carrying a spear; a dart gun hung from his waist, a ring of shiny metal in his nose, and his hair was strewn about his shoulders. There were other things which came to my mind, the bulk of which I'd rather not disclose in writing.

The engineer told me not to make a sudden move for anything, and I immediately had a tremendous respect for his seven years experience in Central and South America.

The so-called man gazed at the whirlybird in amazement, and we sat there looking at each other. Finally, the blades stopped turning and other natives appeared. The engineer decided to try talking with them in Spanish. As he got out of the helicopter I recalled having read somewhere about the remains of the ancient Mayan Indian tribe of Central America being still in existence. It occurred to me that we may have been the first white men these natives had ever seen, let alone the iron bird which swooped down upon them from the sky.

I vacated the chopper soon enough to overhear the engineer say in Spanish that we were Americanos and that we were here to make maps. The native seemed not to understand. He responded in an unfamiliar tongue. Upon closer observation, the native didn't appear quite as hostile as he appeared to be when we spotted him. This made us both feel better.

Suddenly there appeared a stately looking character with a following of around 15 men. He approached us and greeted us in Spanish, a welcome sound. We found out that he was the chief of the tribe of natives, that they spoke an Indian tongue, and that no white man had ever been in this area before. At one time in his early life the chief had been to a neighboring village some 30 miles up the river, which explained his Spanish language proficiency.

The day's excitement ended here. The natives agreed to help us with our survey gear up a 1,000-foot hill. Normally the engineer pays for such help, but these people refused the money, indicating that they had never seen it before and couldn't use it. The day finally came to a close. We said goodbyes and moved on to our jungle camp talking of the event.

Capt Mariano was stationed at the U. S. Army Primary Helicopter School, Fort Wolters, Texas, when he wrote this article.

A Manifold Mystery

William H. Smith

CRACKED MANIFOLDS! One right after another. What was causing it? Captain Mills, the maintenance officer, was about to pop *his* seams.

As he parked his jeep in front of the Officers' Club, Captain Mills kept running this problem over and over in his mind. Was it sabotage? Hardly. A good saboteur would do something worse to the aircraft. There had to be a logical answer, if only he could see it.

It had all started several months ago when 2201 came in with a cracked exhaust manifold. Nothing unusual about that! A mechanic simply installed a new one and the bird was ready to fly again. Then another aircraft had the same trouble. It, too, was fixed. Then more showed up, until exhaust manifolds were being changed every PE or sooner.

At first the captain thought the mechanics might be damaging the manifolds during installation. A careful check showed this was not so. Then he thought it might be faulty manufacturing, but a check with depot proved that this was not true either.

Yet, the aircraft kept coming in with cracked manifolds and the captain couldn't figure out why. Perhaps he should submit an EIR or magnaflux a few manifolds.

Then he got a bright idea. A few days earlier he had met Lieutenant Leber, a new lad in S-3 who had made a good name for himself while serving in Taiwan. Why not ask his advice? A quick telephone call and Lieutenant Leber had agreed to meet him over a cup of coffee.

Inside the cool darkness of the club, Captain Mills found Leber, seated, relaxed, and half through his cup of coffee.

"Hi," the Lieutenant said, at the same time waving to the waitress for another cup.

"Joe," Captain Mills said by way of a greeting, "I've got a problem."

"Don't we all. What's yours?"

Captain Mills told him his sad tale.

For a few minutes Lieutenant Leber sat silent. He was in deep thought.

"Where do these cracks show up?" he asked.

"No particular place."

"Any appear near the bolts?"

"No. If they did I could conclude that our mechanics are overtorquing the bolts. These cracks just seem to materialize out in the open where there is no strain."

"Hmm," Lieutenant Leber said. "I have an idea. What's in it for me if I solve your problem?"

"A steak dinner."

"Could I look your place over?"

"Sure. My jeep's right out front."

At the maintenance shop, Lieutenant Leber asked to see one of the damaged manifolds. It had a small crack right across the face, but there was nothing to show how it got there.

Then he walked around the shop, poking his nose in one place and then another. He talked to the mechanics and even sought out the supply and parts clerk.

"Captain, where is your pencil sharpener?" Lieutenant Leber asked.

"Well, ah . . . we don't have one here. Supply was all out when I last checked and I haven't been back since."

"How do your men sharpen their pencils, then?"

"With a knife, I suppose."

"And the point? You can't get a good point with just a knife."

"Good gosh, how do I know? Maybe they rub the points on the soles of their shoes."

"Well I can tell you how. Your mechanics are using the emory wheel. You can see the marks. But your supply clerk isn't as handy to the emory wheel, so he is using something else."

"Oh, come, Lieutenant. What's pencil sharpeners got to do with my manifolds?"

"Plenty," Lieutenant Leber said. "I suggest that if you want to stop replacing manifolds, you get these boys some pencil sharpeners, especially your supply clerk."

"You're kidding," Captain Mills said.

"No, I'm not," Lieutenant Leber said. "Manifolds have a rather rough surface. Your supply clerk is anxious to turn in neat reports, but he does not have a pencil sharpener. So, he sharpens them on the rough metal of the manifolds. Go in the supply room and look at those replacement manifolds. You'll see pencil marks on just about all of them."

"All right. So what? What does this have to do with cracked manifolds?"

"Don't you see? The pencil lead leaves minute deposits of carbon. As the manifolds get hot, this carbon combines with the metal. The more carbon, the more brittle the metal. End result: a crack at the pencil mark."

"Then the solution is simple: I'll check supply right away. If they're still out of pencil sharpeners, I'll go down to the Book Store and buy one," answered Captain Mills.

Lieutenant Leber turned and headed back towards his office. As he did he called back, "See you later, Captain, and I'll have my steak tonight. Make it medium rare."

THE CHINOOK—
a Personal View

Lieutenant Leonard R. Wilson

EVERY NEW aircraft becomes a subject of much discussion from the drawing boards to testing stages. The Chinook is no exception. Comments have ranged from speculation, to criticism, to praise. Now that advanced user tests are being accomplished, how is the Chinook faring?

It is my intent in this article to present to everyone in Army Aviation just what the capabilities of the CH-47 Chinook are, what maintenance difficulties we are having and possible solutions to the problems.

The CH-47 Chinook helicopter was designed for the Army as a new medium transport helicopter — no more, no less. It will be used to transport personnel, weapons, and cargo to an assault area.

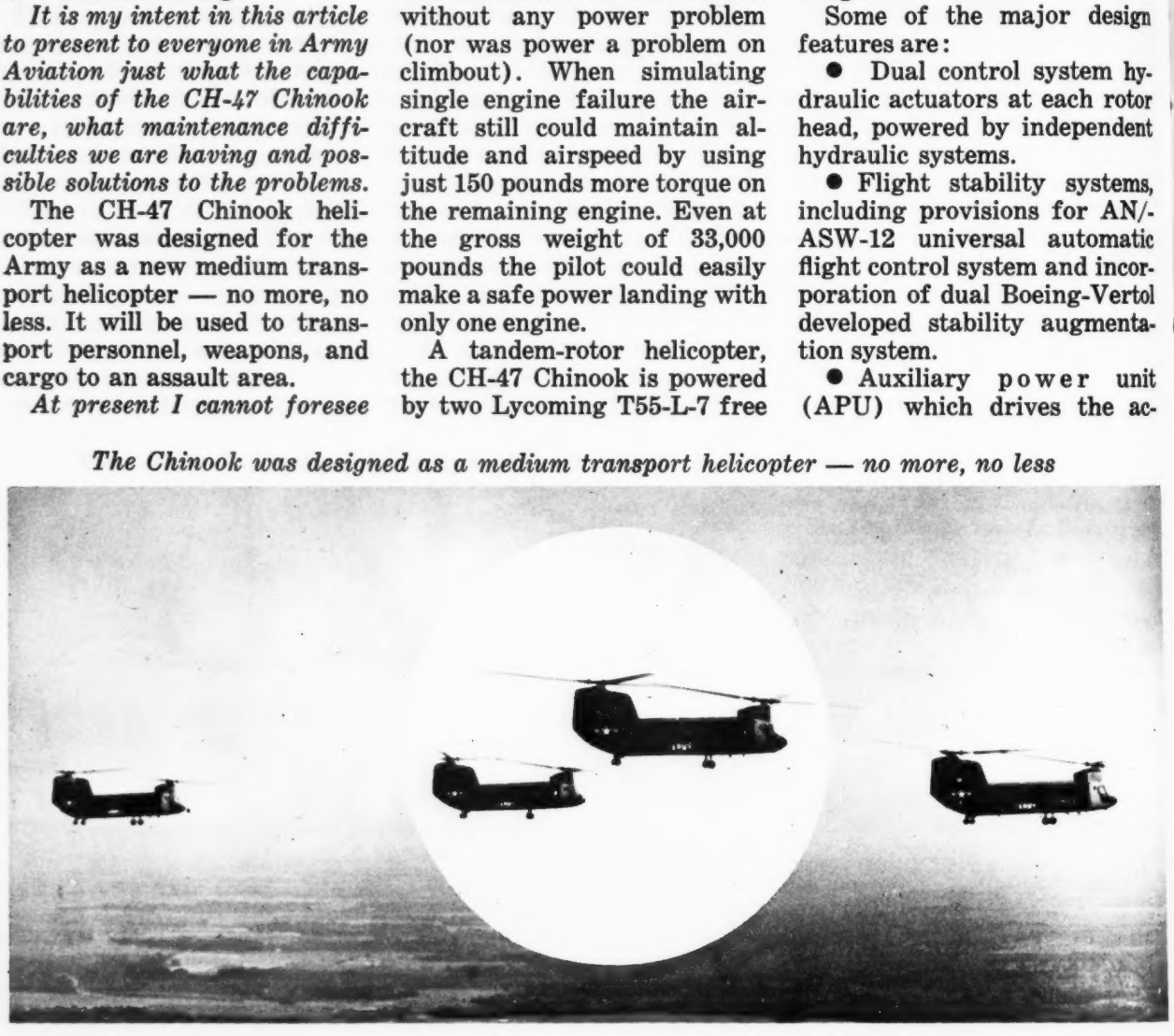
At present I cannot foresee any mission which could arise that the Chinook could not perform. At the Aviation School we have flown the Chinook with a ¾-ton truck and trailer as internal load. In all cases our rate of climb, with 85 percent power, was well over 1,000 feet per minute. Steep approaches were made into confined areas without any power problem (nor was power a problem on climbout). When simulating single engine failure the aircraft still could maintain altitude and airspeed by using just 150 pounds more torque on the remaining engine. Even at the gross weight of 33,000 pounds the pilot could easily make a safe power landing with only one engine.

A tandem-rotor helicopter, the CH-47 Chinook is powered by two Lycoming T55-L-7 free turbine engines. (Present CH-47s are powered by the T55-L-5 but will be changed to -7s.) The engines are rated at 2,650 hp for 10 minutes and a military rating of 2,500 hp each at sea level, standard temperature. For tactical missions 1 and 2, cruise speed for best range is 130 knots.

Some of the major design features are:

- Dual control system hydraulic actuators at each rotor head, powered by independent hydraulic systems.
- Flight stability systems, including provisions for AN/ASW-12 universal automatic flight control system and incorporation of dual Boeing-Vertol developed stability augmentation system.
- Auxiliary power unit (APU) which drives the ac-

The Chinook was designed as a medium transport helicopter — no more, no less



cessory gear box (AGB) and thus can operate all helicopter systems (electrical and hydraulic) independently of the prime engines or ground support power units, while the helicopter is on the ground. This unit utilizes a T62 power turbine as the power source.

- Duplicate A.C. electrical generating system and duplicate A.C. to D.C. converters.
- Provisions in the cargo compartment for 33 fully equipped combat troops or 29 litter patients. Cabin dimensions are 6'6" high, 7'6" wide, and 30'2" long.
- Rear loading ramp openable in flight. It can also be left open in flight to accommodate overlength cargo.
- Anti-icing system for engine air inlets and anti-icing and defogging type windshields.

The subject of touchdown autorotations has been mentioned as one of the downfalls of the Chinook.

I will express my personal viewpoints on the justification of practicing this maneuver. With the introduction of the CH-47 Chinook or any other helicopter with twin-engine reliability we may be witnessing the end of the touchdown - autorotation maneuver. By practicing this maneuver we are disregarding the reliability of two engines. Two engines were provided not only for power but for safety as well. Statistics indicate that more helicopters have been damaged by practice touchdown-autorotations than aircraft that had engine failures.

I know you're going to say, "If the pilots had not practiced the touchdown autorotation, more aircraft would have been damaged." This may or may not be true. The end result shows more aircraft damaged by practicing touchdowns as compared to the number of actual autorotations. In the case of the Chinook, power-recovery-autorotations will be sufficient to give the pilot the

Pershing ballistic missile system checked for compatibility

Various loads were tested with the Chinook to find the best equipment possible for fast deployment of large numbers of troops and weapons anywhere in the battle area

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confidence needed in case of a complete power failure. The probability of two engines quitting at the same time is remote.

The CH-47 Chinook has encountered numerous maintenance difficulties, but not much more than any other newly designed aircraft. The Chinook has not completed final testing; therefore, it's not completely ready for the field. One of the minor maintenance troubles was the brakes sticking after being applied, causing tires to skid and to blow out. This was remedied by a hydraulic return line from the master cylinder. There is no way to foresee difficulties of this nature.

Another maintenance problem was droop stop failure, which caused the blades to strike the fuselage during shutdown. This was remedied by stronger droop stop attaching bolts and stronger metal in the droop stop.

Another difficulty was the failure of the cage in the first stage planetary gear of the fore and aft transmissions. This was apparently solved by making a stronger cage. Also the 90° engine transmission gear boxes have failed due to resonant response of 114D6086 gear. At present the 90° gear box is being fitted with the new type gear.

Currently considerable difficulty is being experienced with problems associated with the Stabilization Augmentation System (SAS). Correction of these discrepancies has been given the highest priority.

With the above maintenance difficulties the aircraft is still flying and is being tested and evaluated at Fort Benning, Fort Eustis, Yuma Test Station, Edwards AFB, Wright-Patterson AFB, Boeing-Vertol factory, the Arctic Test Board, and Fort Rucker. With information gathered from these installations, the maintenance problems will be eliminated and the Chinook should be able to perform its mission as designed.

The demands on this aircraft are great but, believe me, it can outperform any aircraft in its class. Have patience and understand that we are still testing. Give the CH-47 Chinook a chance to prove it is the best helicopter in the world. If you don't believe me, ask the man who flies them.

The CH-47 Chinook was designed to perform the following type missions.

MISSION 1: Deliver 4,000 pounds of internal payload to any point 100 nautical miles distant and return with 2,000 pounds of internal payload. Cruise at sea level. Land with 10 percent fuel reserve. The average speed outbound is 130 knots, cruise time 46 minutes. The initial cruise weight with Mission 1 is 25,700 pounds. In addition, the CH-47 can hover out-of-ground effect at 8,000′/95°F with gross weight 25,700 pounds.

MISSION 2: Deliver 6,000 pounds of internal payload to any point 100 nautical miles distant and return with 3,000 pounds of internal payload. Cruise at sea level and land with 10 percent fuel reserve. The average speed and cruise time is the same as in Mission 1. The initial gross weight with Mission 2 is 27,750 pounds. The Chinook can hover out-of-ground effect at 6,100′/100°F with gross weight 27,750 pounds.

MISSION 3: Deliver 13,701 pounds of external payload to any point 20 nautical miles distant and return. Equivalent flat plate drag of external cargo equals 26 square feet. Cruise at sea level and land with a fuel reserve of 10 minutes for cruise at return gross weight. The outbound cruise speed is 100 knots, cruise time 12 minutes. The return cruise speed is 130 knots, cruise time 9 minutes. Initial gross weight of Mission 3 is 33,000 pounds with which the CH-47 Chinook can hover out-of-ground effect at 8,300′/standard temperature.

MISSION 4: Ferry range of 878 nautical miles without refueling. Ferry time 7 hours. Land with 10 percent fuel reserve. Cruise 150 nautical miles at 5,000 feet at 126 knots average cruise speed with cruising time of 1 hour and 11 minutes. Cruise 719 nautical miles at 10,000 feet at 126 knots average cruise speed with cruising time of 5 hours and 41 minutes. The CH-47 can hover out-of-ground effect at 8,300′/standard temperature. When the Chinook is qualified to operate at an alternate gross weight of 38,000 pounds, its ferry range will be increased to 1,062 nautical miles.

Prerequisites

Major Robert B. Parsons

THE PILOT finished adjusting his seat belt and started the engine, the aircraft poised momentarily on the edge of the field, trembling with life and looking somewhat like the big bird after which it was named. Then the pilot, jockeying the throttle and stick, moved out towards the downwind end of the field. At the end of the field, the Storch turned into the wind and came to a halt.

Flaps were cranked down, followed in a few seconds by application of full throttle. The Argus engine burst into thunderous life, the noise reverberating back and forth between the trees on either side of the field. Directional control during the ground roll was slightly erratic, but otherwise the takeoff appeared to be normal with a negligible loss of altitude as the flaps were raised. The aircraft stayed low and went out of sight as it passed over the trees.

Ten minutes later the Storch was back, entering a landing pattern on a long base leg. Final approach was turned and flaps were lowered. The throttle was partially retarded as the aircraft assumed a glide attitude; however, the airspeed was fast, much too fast for a bird capable of landing at 25 mph. The aircraft continued on final, closing rapidly with the ground. If the pilot had actually planned a roundout, then this day his timing was off, for no action was initiated before ground contact. The aircraft flew into the ground, shuddering from the force of the blow. The main wheels striking the earth cut two 4-foot furrows approximately 8 inches deep into the fresh sod. The Storch bounced into the air, momentarily staggering, as full throttle was applied. Then unabashed, it proceeded to climb out, once again disappearing over the trees.

Within minutes it reappeared on a downwind leg, obviously coming back for another landing attempt. On this second try the performance was so identical to the first that one easily could have concluded that the first approach was a rehearsal for the second. Contact with mother earth was a little less violent, but the result was the same. Recovery and climbout followed the previous pattern. The third attempt was a blueprint of the others, only this time following climbout the aircraft disappeared and did not return for 10 or 15 minutes. Presumably the pilot was planning new strategy.

At last the Storch reappeared, once more entering the

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pattern on a downwind leg. The approach started like the others, but instead of carrying power all the way in, the throttle was completely closed as the aircraft crossed the boundary of the field. A roundout was started, not quite in time, but soon enough that the bounce (when it came) was within tolerable limits. The throttle was not touched again, and after completing a series of bounces, the aircraft finally came to rest *on the ground.* The pilot taxied over to the edge of the field and cut the engine.

Out of the aircraft jumped an American Army sergeant. Instead of looking mad or annoyed, his face reflected the expression of the proverbial cat who has just swallowed the canary. He walked around the plane, examining the wheels and the landing gear and caressing the fuselage as if he were petting his favorite horse. His buddy, who had been watching the show, came running over. The two slapped each other on the back and laughed and joked as if the sergeant had just done the most wonderful thing in the world. Well, maybe he had; he had just joined a very small, very exclusive club: he had successfully soloed an aircraft on his first flight.

Less than an hour earlier on this 7th of May 1945, two Storch aircraft had been flown to this field at Eschenbach by German pilots who had been looking for U. S. troops to whom they could surrender. The sergeant and the corporal, both members of a Field Artillery Group aviation section, had been left to guard the aircraft while the Germans were taken back to Group Headquarters. The sergeant, a frustrated aviator, decided that this was his chance to get into the blue; and being a man of action, into the blue he went.

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One might say that this was impossible, that no one could just walk up to an aircraft, climb in and go flying without some previous instruction. Let's take a look at the sergeant's experience. He had spent over two years as chief of an aviation section with two assigned L-4s. In his work as an aircraft mechanic and in his daily contact with aviators, he had learned basic essentials on the theory of flight. He had listened for many hours to pilots recounting details of particularly daring or eventful flight experiences. He had logged many hours of taxi time. He had observed the pilot actions while riding as a passenger. In his own words, he knew how to fly that aircraft even though he had never done it before.

Not a very impressive program of instruction, you say? Actually, the sergeant was well trained compared with two teenagers who made headlines several years ago when they borrowed (without the owner's permission) a light aircraft and flew it to a neighboring town where an uneventful landing was made. When apprehended by the authorities and asked how they learned to fly, the boys replied, "By reading the comic strips."

Now, what is the relationship between these incidents and the subject of this article? In both cases there was evidence of some pre-solo training. Agreed; not much, but training nevertheless. These incidents represent the extreme minimum amount of preparation for known solo flights. An examination of records at the U. S. Army Aviation School reveals the other extreme in a case where a student actually logged 49 hours of dual instruction before completing a solo flight.

Of what interest is this to Army Aviation? The Army must conduct a flight training program which will get maximum return from minimum expenditure of time, effort, and money. Because of this limitation, the Army flight program must follow a course somewhere between these two extremes. If the program leans in either direction, it must lean toward the side requiring the least amount of preparation. Courses of instruction must be tailored to progress at a steady predetermined rate. There is only room for those who are able to maintain the pace.

To ensure that the maximum number of students who start these courses complete the training, the Army has built into the system a number of prerequisites. Contrary to popular belief, these prerequisites are not intentional barriers constructed by "people on the inside" to protect their personal interests. They are controls designed to filter out individuals who most likely would be unable to complete the course if they had been allowed to enter. The Army does not imply that the people denied entrance to the program are unable to learn to fly. Nor are the people who are eliminated after they enter considered hopeless. If time and money are not limiting factors, then almost everyone can learn to fly. The Army just doesn't have time for slow learners.

Just as the Army filters out applicants for initial flight training, so it controls the input to certain advanced transition courses and to the rotary wing and fixed wing instrument examiner courses. Admission to these courses is usually restricted to aviators posses-

sing high experience levels.

All too frequently, however, students report for an advanced course of instruction without having met all of the prerequisites. Unless some action had been taken to secure a waiver before arrival, this means a waste of time and money, usually resulting in returning the aviator to his unit. Waivers are frequently granted for minor deviations when convincing evidence is provided that the individual is, in fact, qualified. However, this action should be accomplished before arrival at USAAVNS.

Most advanced courses require an instrument ticket which will remain current throughout the course. Of all the prerequisites, this one is undoubtedly the most abused. Past experience has proved that the individual arriving with an expired ticket or one about to expire is usually so far behind on instrument proficiency that he cannot pass a renewal ride. Failure to pass this check, provided courtesy of USAAVNS, is a guaranteed return trip to the parent organization.

The instrument examiners courses are considered among the most difficult courses of instruction conducted at USAAVNS. And rightly so, for the standards of Army instrument pilots will never be any higher than the standards of the instrument examiners. To ensure a quality product and continued high standards throughout Army Aviation, these courses have the highest prerequisites.

Even so, students continue to arrive for the examiners courses minus one or more of the prerequisites, either in whole or in part. Take for example the case of a reserve component officer who had been instrument rated only three months. He was informed that the required period for holding an instrument card was 2 years and that the course was keyed to individuals with at least that level of experience. He was instructed to return to his home station. Instead he brought pressure to bear and was successful in obtaining a waiver. The student returned to the course, but fell steadily behind. He was washed out of the course after his first progress ride. This is a very unsatisfactory experience and one which the average individual would probably prefer not to have recorded in his file.

Both from the standpoint of economy and of training the maximum number of aviators per year, all courses conducted at USAAVNS must be of minimum length, in both calendar days and flight hours. No time is allocated for bringing students up to the desired state of proficiency theoretically established by the prerequisites. This training must be accomplished before arrival.

Examination of the POI for the fixed wing instrument examiner course reveals that flight training includes "review of basic and navigational flight procedures." Do not let this misguide you, as it did one young captain who reported complete with all prerequisites but without any recent flight time in the Beaver. He assumed that it would be a cinch to become proficient during this block of instruction. He learned sadly, and too late, that he was expected to be proficient upon arrival. He not only didn't catch up, he fell so far behind that he was eliminated from the course.

Many other cases could be discussed here but would only be variations of the same theme. It is reasonable to assume that neither the sergeant nor the two teenagers ever heard of prerequisites; and naturally they were not concerned with proficiency, having never flown before. In their cases this is a completely understandable and acceptable position. However, when an officer or warrant officer arrives at USAAVNS not knowing the prerequisites for the course he plans to attend, or when one takes a nonchalant attitude about his proficiency, then somewhere in the chain a link is missing.

Unfortunately a steady procession of would-be students continue to come through the portals of Fort Rucker destined for disappointment — either because they will not be favorably considered for a waiver of prerequisites, or because after a waiver is approved they will find their level of proficiency too low for successfully completing the course of instruction.

An end to this unhappy procession could be accomplished in the field, if these two simple steps were taken:

- All units consult DA Pamphlet 20-21. For information pertaining to branch clearance and waivers, read paragraphs 6 and 9 of Section I. For information on Army Aviation courses and prerequisites, read pages 49 through 80.

  For courses of more than one month duration, send requests for waiver to DA.

- Commanders ensure that adequate training time is made available to prospective students to permit attainment of a high degree of proficiency *before* arrival at USAAVNS.

Taking an aircraft — or a woman — for granted can be dangerous. If you "know all about the U-6," then perhaps it's time for you to take another look at

The Beaver

Captain David M. Monroe

ANDY AVIATOR gassed his Beaver just before hitting the club one night — full tips, full mains, the works. He got up early the next morning, raced to operations, filed a clearance for a 500-mile nonstop flight, and bugged out . . . only to make a forced landing in a rice paddy 490 miles away. Our boy left the tip transfer valve in the "Both" position overnight. The fuel flowed out the overflow vent.

Over the years the Beaver has proved to be a reliable flying machine. However, as any aircraft, the Beaver does have its own idiosyncrasies that play a very important part in achieving optimum flight performance.

Because it has been with us for such a long time it is often taken too much for granted. Many of the seemingly insignificant preflight and flight items are ignored. When this happens the reliability of the machine deteriorates. Accidents, injuries, and fatalities result.

Capt Monroe flies for Northwest Airlines. This article is based on experience gained while flying with the Minnesota National Guard.

Weight and balance is one of the many items often overlooked on the preflight of the Beaver. How many times have you heard an aviator say, "I just filled the tips, told the five people to climb aboard, and blasted off"? Sure, he probably made it to his destination, but I'll bet the runway looked pretty short on takeoff, and in any event his airspeed probably suffered. Beavers have different basic weights because of various equipment bolted in and on the machine. The only way to know just what your Beaver is capable of is to check the latest weight and balance information.

What other small items are missed on the walk-around? How about the airspeed indicator? Knots or miles? You'd play hell on a dark night making a missed approach at 200 feet if you thought you were reading knots when in reality it was miles. Tachs also never seem to be standard on the Beaver. Some have a digital counter to read besides the needle. This particular instrument is hard to read in the daytime, let alone on a stormy night.

Then we come to seat adjustment. Did you ever hear of someone carefully adjusting his seat, then taxiing off, only to end up halfway back in the cabin the first time he tapped the brakes? It's happened to me, and proved rather embarassing when I hit the right brake and missed the left.

For some reason the Beaver does not have positive lock type door latches. All four latches should be double-checked after the passenger and crew are boarded. A good method is to pull on them from the outside before you, the pilot, climb into the wisdom seat. Speaking of doors, let the passengers know just what the big red handle is and explain how to use it. Some people think it's a handhold and could be real surprised in flight. Take it from someone who has been upside down on the ground, and learn where these handles are and which way to turn them. I looked all

"Let's get going!"

over for that handle once while standing on the roof of the cabin. Everything looked reverse, and was.

Let's start the machine and get moving, but right after we start moving, let's check the aircraft's ability to stop moving. When testing the brakes on the Beaver, let's remember that we want a good stiff pedal on both brakes. These brakes are hard to keep adjusted and cause a lot of first and second echelon headaches, but one good and one no-good brake on a Beaver is like playing with avgas. Just try a short field landing with a brake out. Taxiing for long periods in snow or slush can also be a problem. The slush melts into the brake area. If the ship is then flown in severe cold this can freeze, locking the wheel tighter than a Jayne Mansfield skirt. Needless to say, landing would be another problem.

Now that we've got the machine to the runup block, let's learn all we can about the condition of those 9 jugs, 18 ignitors, and 2 paddles. Temperatures and pressures O.K.? Remember 40 on the oil, and 100 on the cylinders. This holds true not only for the Beaver but for most other reciprocating engines. Without the 40° it is impossible for the engine to live up to its design specifications. Oil won't flow when it's cold, and it has to flow to lubricate and cool. So, the temps and pressures are in the green.

Let's run the prop through a couple of times to loosen up the oil in the dome. Remember, on a cold day that oil is pretty thick, so run the prop control through half a dozen times to get it functioning properly. Once in flight the prop governing mechanism is forever cycling from high to low and back, but if the oil is left congealed before takeoff, the governor may not be able to control at all.

The power check comes next. Run the engine up to 1750 rpm. What's the manifold pressure? — 23″ plus or minus one? If it isn't, then something's amiss. Your engine is not putting out the power it should. Cylinder inop? Why? Could it be fouled plugs? Could be. Now, especially while using 115/145 fuel, the plugs have a tendency to foul out. You've all heard long spiels on lead deposits, etc., etc. They probably went in one ear and out the other. But it's during the power check that fouled plugs can be detected.

We don't have a flight engineer and engine analyzer allotted to the Beaver, so we have to detect and analyze the situation ourselves. If you do suspect fouled plugs due to a

"Tilt"

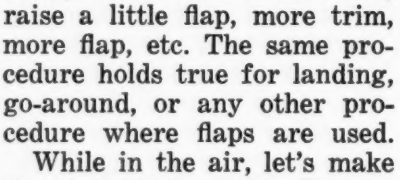
lack of power or large mag drop, run the engine up to field barometric pressure for one minute and then back to 1750 rpm, and mag check it again. If this doesn't work, take it back to the hangar. Above all, don't fly it unless it checks out! Speaking of mag checks. I've seen an awful lot of mag checks performed like a photo finish at Hialeah. Check the drop carefully and know exactly what it is.

Now comes the hairy part. When taking off in the Beaver, several things have to be considered. How many of you know that the Beaver should not be operated in a crosswind with more than a 10-knot component? Hard to believe? Crosswind operation of any degree in the Beaver is a marginal operation. The flaps tend to blank out the tail, the fuselage tends to weathervane, and the wings are just one big old "Clark Y" airfoil.

I find that the longer you can keep the tail on the ground, the easier the ship is to keep straight. Also I use "Climb" flap position instead of "Takeoff" when not operating out of short strips. The slower the power is brought in on the initial part of the roll, the more chance the tail wheel has of locking properly. That tail wheel can be a great help if it locks at the beginning of the takeoff roll with the aircraft headed in the right direction.

Going back to flaps, for some reason many aviators just have to get those flaps up immediately after liftoff. Get that required altitude, and then some, roll in a little back trim, raise a little flap, more trim, more flap, etc. The same procedure holds true for landing, go-around, or any other procedure where flaps are used.

While in the air, let's make the aircraft fly right. If your weight and balance was correct when you left, the ship should stay well within the limits of trim for the rest of the flight. You can, however, add a few extra knots to the airspeed by



moving the center of gravity forward. About the only way you can do this in flight is through proper fuel management. Use up the rear tank fuel first and then the center, etc. This will vary a little if the tips are being used.

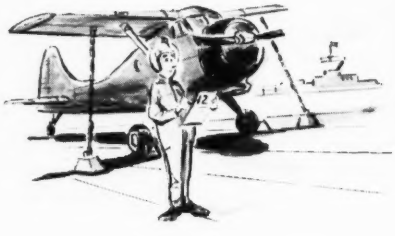
Turbulence is not one of the missions the Beaver was designed to meet. In rough air it flies like a semi-controllable box. Remember to slow to 100 knots in rough air. That's what the book says, but it seems to me that's about max cruise for some birds. The -10 tells a very pretty story about how to fly this Beaver kite through thunderstorms. This, to me, is sheer nonsense. I doubt if anyone has ever actually survived a trip through a mature cell with a U-6. Just don't do it.

An excellent knowledge of systems is the best emergency procedure I know. This, along with the knowledge of just what the Beaver will and won't do, should take care of you. The fact that the machine loses 2,000 feet of altitude for every 3 miles forward, zero wind, power off, should impress many of you, but on second thought this doesn't mean too much. The day your engine quits, you're not going to think of 2,000 and 3. If you don't know how far that thing will glide, by then any glide ratio is meaningless.

Ground mileage is just about impossible to judge from the air. Terrain elevation makes it even more complicated. In the event of a forced landing remember the two things you can vary. The flaps and the props can be put to good use in adjusting a forced landing approach. The prop is the one usually forgotten, but pulling the prop control back really increases the glide ratio. Remember, the general tendency in a forced landing is to overshoot, not undershoot, the spot of intended landing.

Now we get to the problem of landing. A great aviator once said, "The secret of flying is to keep the takeoffs and landings in a 1 to 1 ratio." There are many theories on this landing thing. Some say plan every approach power - off, while

"Well done!"



others say power-on. I like to do power-off approaches once in a while for practice, but power-on is the one I use most. A power approach allows you to maintain a lower airspeed on a short field landing. It keeps more air flow over the wings and tail for greater directional control and more lift.

It's the power approach that is used in instrument work. Not too many people are prone to cross the outer marker and wipe off the power to come down the glideslope. The Beaver is an excellent airplane on a low airspeed power approach with a short field ahead of it. Use full flaps and control the airspeed all the way to touchdown with power. I find that after touchdown, getting the copilot to raise the flaps immediately puts more weight on the wheels for braking. It also gives you more elevator control during initial landing roll.

The flight is now complete; the chocks in place, switches off, fuel selector off, tied down, etc. The flight isn't over, however, until the ship's log is complete. Getting the individual pilot time recorded in the book is the thing most pilots do with precision, but this leads to a hurried up completion of the -12. The only way any airplane can be kept in top condition is to carefully, I repeat, carefully write up any discrepancies you may find during your flight.

In writing up discrepancies a knowledge of systems again comes in very handy. Again the seemingly insignificant item can be the clue that leads to the discovery of something major. That extra 15° of cylinder head temp can lead to a major internal failure. If properly written up, a discrepancy may mean saving the lives of the next crew. Remember, only you, the pilot, can tell the ground crew the true condition of the aircraft. Remember also, that the -12 lets the next pilot in on the secret of the machine. Think of what you're going to write up; write it so others can read it; and then tell the crewchief verbally. Poor maintenance is over 50 percent pilot error.

A record 100,000 accident-free flying hours while training students was chalked up in 1963 by the Instrument Flight Division of the Advanced Fixed Wing Department, U. S. Army Aviation School, Fort Rucker, Ala.

The record was made by the division in the single engine U-6A Beaver. Approximately 2,000 hours of the flying time was instrument and weather time. No other military service has exceeded this record for instrument training in single engine aircraft.

Murphy's Law* Applied to the Digest

*When an incorrect form can be used to request the DIGEST, then someone will use it.

Many individuals and units experience unnecessary delay in getting the DIGEST or enough copies of it by sending their requests to the editor. Distribution is not made from Fort Rucker. The Adjutant General makes distribution from Baltimore, Md. The correct way to get the DIGEST is so easy.

Here's how easy:

Active Army units submit a DA Form 12-4 to the AG Publications Center, 2800 Eastern Boulevard, Baltimore, Md., requesting the number of copies of the DIGEST needed to fulfill their requirements. If your unit is of company or battery size or smaller, send the DA Form 12-4 to the next higher command for approval and forwarding to the CO, AG Publications Center, 2800 Eastern Boulevard, Baltimore, Md. All other units, organizations, or headquarters submit DA Form 12-4 directly to Baltimore.

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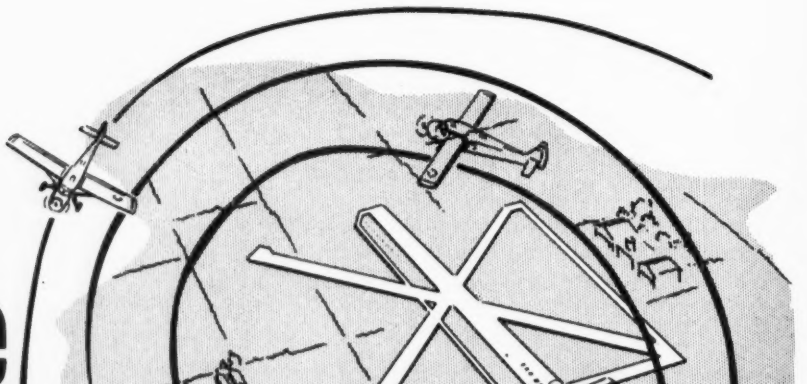
If you are the "Old Pro" type and want to "preflight" your requests, read the details in Section 3, Chapter 3, AR 310-1, dated 20 March 1962, and DA Circular 310-57, dated 14 March 1963.

Mechanics as well as Army Aviators need the safety information in the DIGEST. So determine the number of copies needed to satisfy promptly all reader demands.

thrice around the peapatch?



Lieutenant Dennis A. Lazar

SOME NEWLY rated Army Aviators regard it a gross degradation of personal pride to admit any flying deficiency — the deficiency brought about by not being current in the aircraft or in the type of flying they intend to do. About all they want for a currency check is to whip around the peapatch three times and boot out the IP. Many other Army Aviators do have the good judgment to request instruction in the type of operation as well as emergency procedures.

Three times around the traffic pattern does not qualify an aviator to immediately go out and tackle the most difficult strip he can find. This is only a starting point to regain your control touch and to refresh your memory with the correct operating procedures.

Let's be honest with ourselves. If we are not really current in an airplane, we cannot expect to zoom off and be ace of the base at the first crack out of the box.

You might find the following suggestions helpful. Don't try to force the airplane into anything. For example, forcing the tailwheel off the ground on takeoff presents problems that multiply one another. When the tailwheel is forced off the ground with forward stick pressure, the rudder has not really become effective, so directional control depends essentially on brakes.

Each brake application during a takeoff roll can lengthen that takeoff roll by as much as 50 to 100 feet! This alone can

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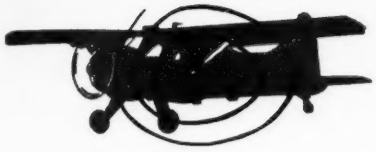


make the difference between successfully clearing barriers and not clearing them. Also, when we must depend on brakes for directional control, there is the common tendency to overcorrect.

TAKEOFFS

Poor pilot technique definitely does affect aircraft performance. When a three-point takeoff is attempted, the takeoff distance is increased considerably due to slower acceleration caused by drag of the higher angle of attack.

On the other hand, an excessively tail-high takeoff consumes more takeoff area because the aircraft cannot become airborne as soon as it has sufficient speed.

Takeoff from short field is doubtful when the aviator forgets to lower takeoff flaps.

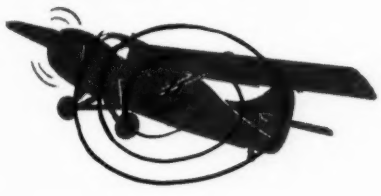
Failure to remove carburetor heat for takeoff will not allow the engine to develop full power, which results in increased takeoff distance.

These mistakes may sound stupid, but they are committed every day.

You should perform a complete pre-takeoff check, regardless of the kind of takeoff you intend to make. This is the only way you can ensure that the aircraft, as well as yourself, is ready to go.

A normal takeoff should be made by aligning the aircraft with the runway and applying power slowly and smoothly as the aircraft accelerates. Hold the stick back until enough airspeed is attained to require noticeable back pressure. At this time relax the back pressure on the control stick and allow the tail to come up to just below the level flight attitude. In this attitude the aircraft will fly itself off the ground with comfortable airspeed.

For short field takeoffs be sure that takeoff flaps are extended. Align the aircraft with the takeoff area and while holding the brakes apply full takeoff power. Ensure that the engine is developing enough power and release the brakes quickly. Hold the stick full back to keep the tailwheel on the ground for positive directional control. The elevator will become aerodynamically effective after the rudder, so you can tell by the amount of back pressure necessary when there is enough relative wind for control effectiveness.



Release the back pressure and allow the tailwheel to just clear the ground. Maintain this attitude and the airplane will become airborne at the minimum flying speed. In a rough strip allow the tail to come up a little higher to reduce the angle of attack. This will prevent the airplane from being bounced into the air before it has attained sufficient airspeed.

On the climbout, whether from a 5,000-foot runway or a 900-foot strip, make sure that you have sufficient airspeed before retracting flaps. A good rule of thumb is to accelerate to normal climb airspeed before you retract the flaps.

Are you prepared for an emergency situation—a forced landing or perhaps just a simple radio failure? You should carry a checklist to cover procedures for mechanical or electrical malfunctions. You should also carry a lot of common sense for all emergency situations. Included should be a concrete plan of action rehearsed mentally many times over for the event of a forced landing. It is much easier to remain calm and accomplish the necessary procedures if you have a plan in mind.

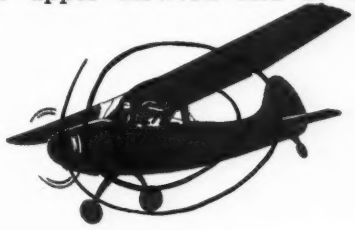
APPROACHES AND LANDINGS

Well now to that rather tattered and overused adage that still applies to Army aircraft, "What goes up must come down." The idea is to come down easy, so we cannot minimize the need for good approaches and landings.

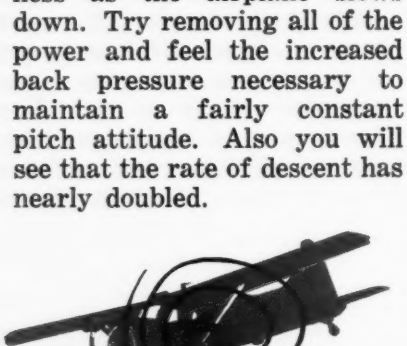
While you are still trying to get the feel of the airplane don't try any short field approaches, but make normal landings with moderate flap settings. It will be much easier to judge your roundout if you look down and out at the runway at about a 30° angle to the nose. If you look directly over the nose you may roundout too high and drop in. If you look straight down to the side, you will fly into the runway and not be able to maintain runway alignment.

After you feel proficient in normal landings and want to tackle short field work, consider these suggestions.

Fly into an area designated for upper airwork and at a



safe altitude set up several practice power aproaches to terminate 1,500 feet above the ground. Try power approaches with the different configurations of flap settings and pitch attitudes. In some of your practice approaches, raise the nose above the normal power approach attitude and notice the reduced control effectiveness as the airplane slows down. Try removing all of the power and feel the increased back pressure necessary to maintain a fairly constant pitch attitude. Also you will see that the rate of descent has nearly doubled.



Make several turns in the power approach attitude and note that you must lower the nose to compensate for loss of lift. Additional power must be applied to maintain the correct descent. When you are satisfied with your power approaches, head for a strip.

Choose as a starter a strip that is fairly level, has a smooth surface, low barriers, and is of sufficient length. Perform a reconnaissance and if the strip is safe for aircraft operations, set up your approach.

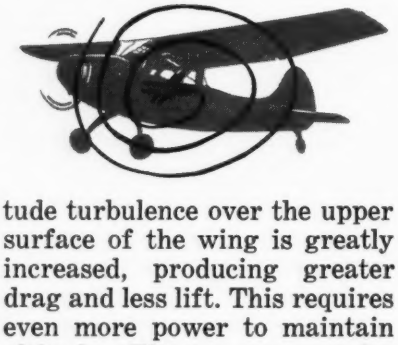
Moderation is the key word in your power approach pitch attitude. Do not allow the nose to get excessively high or low.

A nose-low attitude will give you more speed and a steeper angle of descent. This will make it difficult to hold the sight picture of the touchdown area that will ensure a good approach. To land the aircraft in the shortest possible distance a three-point landing should be used. If a power approach is made nose low with the faster resultant speed, we will have to start our roundout early and transition to the three-point attitude slowly.

The chances are that if an aviator did not realize that he had a nose-low power approach attitude, he could not detect the need for an earlier, slower roundout. If the roundout were made late the result would be to float down the strip in the three-point attitude. In fact, each additional 5 knots airspeed above stall speed in the flareout will lengthen the landing distance 50 to 75 feet.

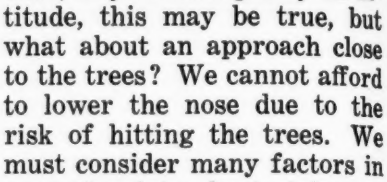
On the other hand, a power approach with the nose above the level flight or normal power approach attitude is bad news in my opinion. Some aviators have the misconception that an excessively nose-high power approach is the ideal way to control the descent with power. This is commonly known as "hanging it on the prop," and is a surefire way to let the aircraft get behind the power curve.

With the nose above the normal power approach attitude turbulence over the upper surface of the wing is greatly increased, producing greater drag and less lift. This requires even more power to maintain altitude. The more you raise the nose, the more power is required to maintain controllable flight.



BARRIER APPROACHES

Right about now you feel that these problems are academically simple to correct. Well, if you have plenty of altitude, this may be true, but what about an approach close to the trees? We cannot afford to lower the nose due to the risk of hitting the trees. We must consider many factors in operation into short strips.



Here is an example of how a relatively inexperienced aviator fared in an approach into a strip when he should have been practicing them 1,500 feet higher until he was more adept.

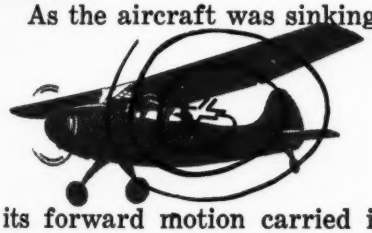
The power approach was attempted into a short strip with 60-foot high barriers on a hot summer day in a gusty wind condition. The approach was established, but there was difficulty in maintaining the desired descent due to convective currents and gusty winds. A landing flap setting was used and a good power approach attitude was set up until an updraft placed the aircraft well above the desired line of descent. Throttle was reduced and a little back pressure applied to maintain a constant pitch attitude. The aircraft descended to the desired sight picture and power was applied to govern the descent, but the same back pressure was maintained, causing the nose to come up slightly. The aviator thought it would give him more positive control to hang the aircraft on the prop.

As the approach progressed and the edge of the barriers became fairly close, it appeared that the aircraft would be high, so full flaps were lowered. At this point our aviator had the

bad combination of full flaps, an excessively nose-high attitude, with plenty of drag and a minimum of lift. At any rate the approach was continued. Just short of the edge of the barriers, suddenly a downdraft was encountered, and the aircraft began to sink toward the trees.

Our newly rated aviator's lack of longevity in the cockpit began to get him into real trouble now. That old self-preservation instinct of pulling back on the stick took over, causing him to react impulsively. This increased back pressure caused the aircraft to lose more lift and sink into the trees. Almost as an afterthought, full power was applied in an effort to struggle away from the trees standing ready to impale the aircraft. The airplane was now on the backside of the power curve, and there was only one way to go — DOWN.

As the aircraft was sinking,



its forward motion carried it through the tops of the trees to the vast landing strip beyond. A few anxious moments passed and the airplane finally lumbered back into controllable flight; a go-around was executed.

Let's analyze the mistakes and factors involved in this experience.

First: This aviator never should have tackled this strip until he was more current in the aircraft and power approaches.

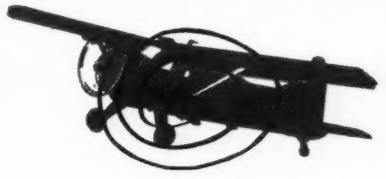
Second: A proper power approach attitude should have been maintained, especially in gusty wind conditions. Raising the nose to achieve better power control is wrong. When you reduce the power the aircraft will react quickly to descend, but when you add power to slow the descent the aircraft will be very slow to respond.

Third: Full flaps should not have been used in a gusty wind condition and most certainly should not have been lowered just before crossing the barriers. Whenever flap settings are changed or the aircraft is retrimmed, the aviator suffers a momentary change in control pressure. So temporarily it is difficult to predict what the airplane is about to do.

Make sure that you take all factors into consideration before you attempt any short field approaches. Your roundouts will begin at approximately the same height as for a normal approach. In a power approach, they will be slower, so the three-point attitude is not exceeded. Decrease power as necessary in the roundout to govern the descent all the way to touchdown.

Closing the throttle too fast will result in a stall and dropping the aircraft in. Failure to reduce power quickly enough will cause float and increase the landing distance.

Once on the ground you cannot relax until the airplane is completely stopped. Any wet grass, mud, water, sand, or uneven surface can adversely affect directional control. Use moderate braking action, because all traction is lost when the wheels are skidding. In sand, a skidding tire will push



the sand in front of it to form a sort of chock.

Plain good old logic and common sense should be used when renewing your currency in short strip work and our basic aircraft.

The foolish aviator who goes around the peapatch three times and starts out to tax the aircraft and himself to the utmost has just one problem: his capabilities are overtaxed long before those of the aircraft.

It is better to be careful a thousand times than to get burned just once. Each item of your flight clothing is designed for your protection. Give yourself the break you deserve by wearing it correctly.

How long has it been since you have reviewed the emergency procedures for each type aircraft you are qualified to fly? The time to do this is now, not when you have an emergency.

crash sense

PREPARED BY THE U. S. ARMY BOARD FOR AVIATION ACCIDENT RESEARCH

no matter how you slice it, the giant's share of any accident pie chart can always be labeled...

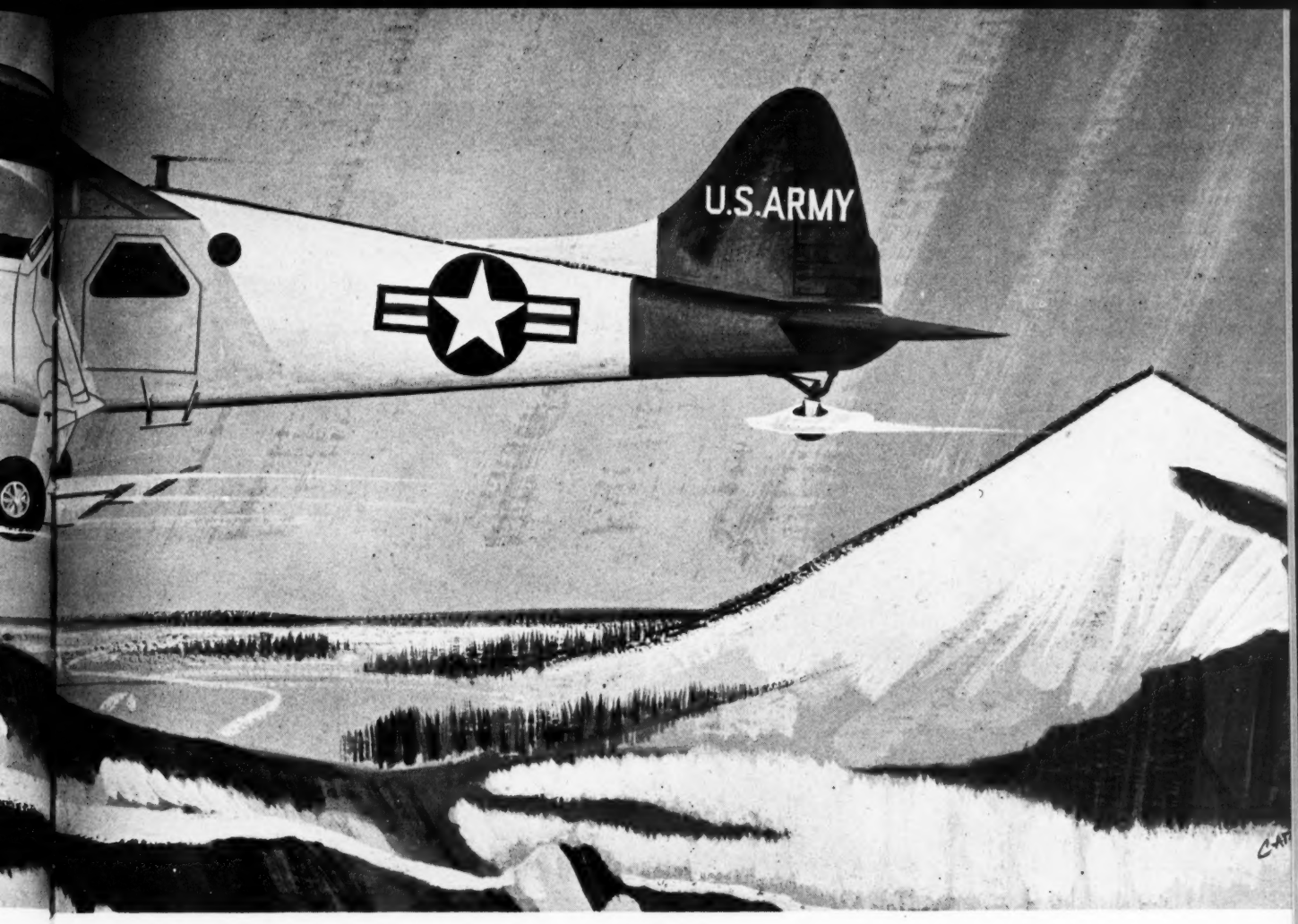
HUMAN FACTORS

A SKI-EQUIPPED Beaver with a pilot, crewchief, and two passengers aboard took off at 1000 hours for a VFR round-trip flight. Weather reports indicated that the ceiling and visibility would be good for the outbound and inbound legs, but that the ceiling would lower to approximately 2,000 feet during the afternoon. One of the passengers, the ranking officer in the party of four, rode in the copilot's seat. The crewchief and the remaining passenger were in the rear seats. The flight route was over a desolate area of mountains, ice, and snow. There were no en route refueling points. However, with full tanks, the aircraft had enough fuel for the round-trip flight and a 30-minute reserve.

Here is how the pilot described what happened: "We spent an hour at our first stop, then flew on to the second stop. There was a little more wind there, but it was still good weather. It was getting late and I kept urging my passenger to complete his business as we had filed a flight plan which would have put us back at base by 1500 hours. I almost told him that we couldn't go on because it was getting too late.

"As we were leaving for the return flight, I realized we had a lot more wind than before. It seemed to be coming from the left. My radio was weak and I couldn't get a good clear signal at any time. I also noticed that the gas supply was lower than it should have been. I don't know why, unless it was the frequent warming up on full rich that brought the consumption up.

"We approached the mountains and I attempted to get on top of a layer of clouds. I couldn't make it because of the wind, so I went around the clouds. Finally, after maintaining a course for a while, I was above a layer of clouds but I could still see all the mountain tops. I could also see streaks of light in the sky ahead. We were not making very good forward speed.



We were flying at about 7,000 feet when we reached a bank of clouds I couldn't fly over. I did not have enough gas to turn back, and the plane was icing badly. I could not gain altitude. We were definitely in weather.

"I had my shoulder harness on and locked. I attempted to have my passenger put his harness on, but he made an attempt and abandoned it. Later, I tried again to get him to put on his shoulder harness and the crewchief tried to help him, but he wouldn't put it on.

"The front gas tank was the only tank left, as I had used the rear and the center tanks until the red light went on to make sure they were empty. The front tank registered approximately eight gallons. I started a slow descent and I could see the hills beneath us. At about 2,000 feet, I saw a hill ahead of us. We hit it, but kept on going, then hit again. The wind was very high and there was considerable turbulence in the valley where we hit."

And here are some excerpts from the crewchief's account:

"We took off for home at 1415 hours. The pilot figured it would take us an hour and ten minutes to get back to our base.

". . . We ran into bad winds. There were clouds and snow. The pilot made a circle and climbed in the weather. We were past the point of no return due to the gas supply.

". . . All this time, the pilot was trying to get hold of our base by radio. But there was no answer. He worked the dial and could still get no answer. We began to pick up ice and lose altitude.

". . . The pilot told the passenger in the copilot's seat to put on his shoulder harness. The passenger said he didn't like to wear them. I was sitting back of him and handed the harness to him. He monkeyed with it for a bit then threw it down.

". . . It seems to me that we made a circle,

Investigators check wreckage on mountain slope

Pilot's microphone had missing mounting screw, which caused intermittent operation and probably blocked reception

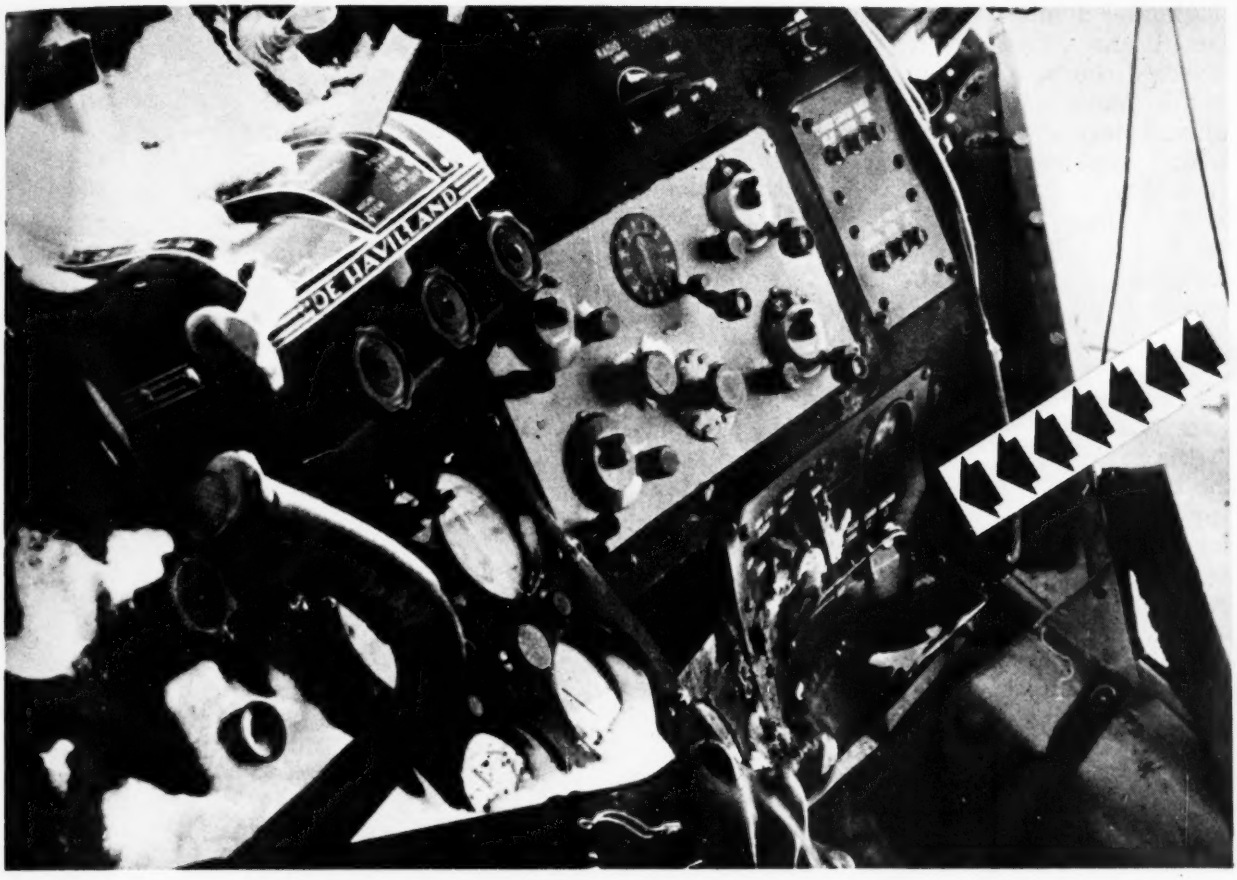
then bounced once and hit again. We hit hard.

"I crawled out over the passenger beside me and ran away. There was no fire, so I got back to the plane. I tried to talk to the pilot but he was unconscious. The other passenger helped me get the pilot out of the aircraft. We put him in a sleeping bag inside the aircraft. The wind outside was very strong, about 75-80 mph. We couldn't even take our gloves off without freezing."

The passenger sitting in the copilot's seat was thrown violently forward at impact. His head struck the instrument panel, bending in the panel approximately 4 inches and causing a severe concussion from which he later died.

The crewchief and surviving passenger made the pilot as comfortable as possible the following morning, then made their way down the mountain to find help.

The basic cause of this accident was best summed up by an experienced bush pilot from the area who helped in the search and rescue. He said: "The pilot was new here. The others



Panel shows indentation made by passenger's head. Passenger was not wearing shoulder harness.

of us who know this area well would never have flown over the hills with the weather like it was. With a low ceiling, those hills with no vegetation and the clouds blend together and you can't see. Those who fly around here regularly follow the beach. If you follow the beach and find you can't continue, you can land or turn back.

"We had a hard time locating the plane. Not knowing the pilot too well, we didn't know how he would react and what he might do under the circumstances. Those who know the area would have hugged the river or followed the beach, where you can keep an eye on something. You would not be able to see the river from the altitude he was flying."

The pilot's radio transmissions before the crash were heard loud and clear at the base. Each transmission was promptly answered, but these answers were not heard in the aircraft. During the investigation, all radio equipment was removed from the wrecked aircraft and bench checked. These tests revealed that all radio equipment was in excellent operating condition except for the pilot's microphone. One mounting screw was missing from the microphone, causing intermittent operation. This was what probably blocked the pilot's reception of transmissions from the base.

The crowning factor in this particular accident played no part in causing the accident. But it could have played a vital role in saving the lives of the three survivors. Although this flight was to be made over extremely rugged and desolate terrain, only two bed rolls were carried. Other survival gear was left behind because, in the words of the pilot, IT WOULD HAVE CAUSED THE AIRCRAFT TO BE OVERLOADED.

• • •

IT WAS A HOT summer afternoon. The unit, taking part in a field training exercise, had its CP located east of a crossroads near a small southern town. The aircraft was an OH-13H. Here are excerpts from some of the eyewitness accounts of the accident:

Another aviator: "I saw the aircraft depart the CP area. Two or three minutes later, as it reversed course and headed west, I heard the engine make a sound similar to a backfire. Immediately after the backfire, I saw it fall behind some trees, which obscured it from my view. Smoke rose almost immediately. I went to the scene of the accident by jeep, but arrived too late to be of any assistance. Prior to the backfire sound, I may have heard irregular rpm sounds from the engine, but these could have been caused by wind shifts. I am qualified in the OH-13H aircraft."

Crewchief: ". . . He put his helmet on and gave [the aircraft] a mag check and took off in the same direction he came in. He cleared the trees about 50 feet and I couldn't see him any more. About a minute later, I heard what sounded like a loud backfire and the engine was dead. A couple of seconds later, I heard another bang. I grabbed a jeep driver and proceeded to the scene. When I got there, [the aircraft] was upside down and on fire. I helped to put out some of the fire that was starting to burn in the field and keep the people away from it."

Another aviator: "I had landed at the CP and just shut down as the OH-13H was taking off. I watched it make a normal takeoff to the west and climb to about 200 feet before I looked away. The next thing I heard, the engine quit, sputtered once or twice, and then completely quit. I looked up, expecting to see a normal autorotation. Instead, the aircraft pitched down sharply and spiraled to the right. I would say at this time he was approximately 300 feet above the ground and 500 yards or so from me. It seemed as though everything had stopped turning and the aircraft fell free-fall and completely out of control."

The aircraft crashed in a near inverted attitude approximately 200 yards west of the intersection. It burst into flames on impact and burned. The pilot was killed.

During the accident investigation, the following items were noted:

The magneto switch was found in the OFF position.

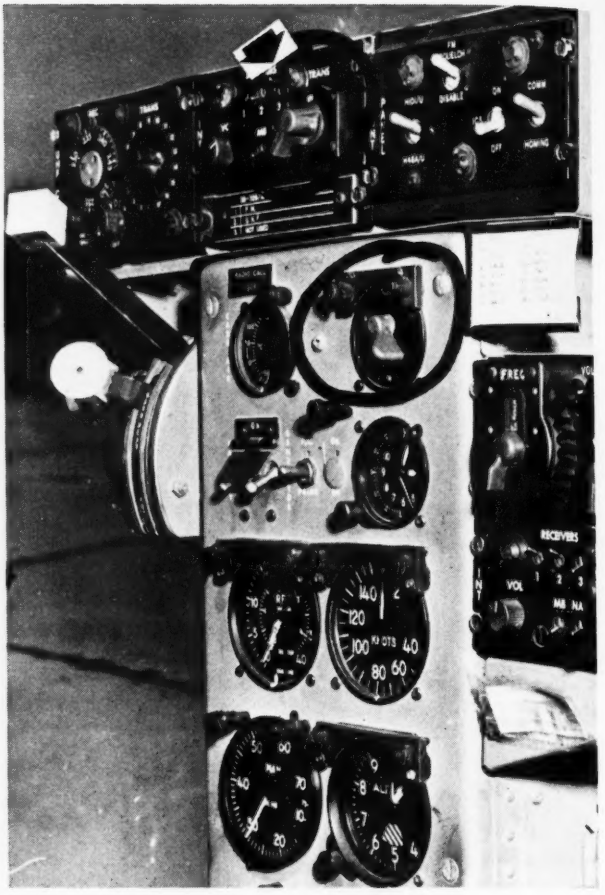
Engine and transmission oil pressure gauges indicated ZERO.

The engine tachometer indicated ZERO.

The rotor tachometer indicated 2450 rpm.

These indications could be correct for the time of the crash or they could have been produced by impact.

All control tubes and linkages appeared to have been connected and functioning at impact. However, some of the control rods and tubes were burned.



OH - 13H instrument console. Note small separation between transmission selector and magneto switch.

No violent flapping of the main rotor blades was noted, which is indicative of a very low rotor rpm.

The tail rotor drive shaft and gear box showed no evidence of failure.

The tail rotor blades were intact, but bent toward the tail rotor guard.

The aviator, who completed his fixed wing training approximately 2 years before the accident, had a total of 666 flying hours. Of this total, 580 hours were in fixed wing aircraft and 86 hours were in rotary wing aircraft. He completed the rotary wing qualification course 18 days before the accident. When he returned to his unit, he transitioned into the OH-13H, five days prior to the accident.

The aviator had requested that he be permitted to remain at his home station and not

participate in the field training exercise because he had received orders for overseas assignment which called for him to leave shortly after the end of the exercise. He also listed other personal reasons, but it was decided that he would have to go because of the need for pilots.

The true cause of this accident is unknown and it will very likely remain that way. Based on available evidence and witness statements, investigators came up with three theories that could have caused this accident. They are:

Theory 1—That the pilot removed his left hand from the collective pitch stick and used it to control the cyclic stick, reaching with his right hand to change the radio channel selection switch from the intercom position to the FOC position and inadvertently shutting off the mag switch. During the investigation, the radio selector switch was found to be still in the intercom position, and the mag switch was found in the off position.

Theory 2—That the pilot changed hands on the controls after discovering he had taken off with the mag switch on the right mag position instead of the both position. Attempting to correct this situation, he could have inadvertently shut the mag switch off.

Theory 3—That the pilot was making an inflight mag check and inadvertently turned it to the off position.

With cruise manifold pressure, turning the mag switch off in the OH-13H will result in a loud bang, which could explain the backfiring noise heard by several witnesses. If the pilot had his hands on the controls as described and inadvertently shut off the mag switch, rotor decay would be very rapid, even though he took immediate action to reduce his collective pitch control. The loud bang, slowing of the rotor blades, and uncontrolled flight described by witnesses, would be the result.

AT MID-MORNING, ten passengers and a crew of three, pilot, copilot, and crewchief, boarded a CH-34C. After takeoff, a gradual climb to the south was made along a four-lane divided highway. When the aircraft reached 1,300 feet, approximately 4 minutes after takeoff, the engine failed. The pilot entered autorotation and slipped toward the highway. He did not retard the throttle and the engine surged back to almost normal rpm after the autorotation was started, then failed again.

The terrain below was heavily wooded and the highway offered the only open area. Traffic was heavy in both directions, so the pilot selected a touchdown point on the sod strip dividing the highway. He noted a vehicle moving south on the highway at about the same speed as the aircraft. As the autorotation continued, he saw that the sod between the highway lanes was ditched in a V shape and there was a concrete manhole at his intended touchdown point. Considering that a crash was probable if he continued straight ahead, and that he would probably land on the automobile beneath him if he turned right, he was faced with a nearly impossible choice.

At approximately 100 feet above the ground, the engine once again surged back to almost operational rpm. The pilot entered a flare and decided to use the engine for a power recovery, then land on the right lane of the highway. As he attempted to pull pitch and rejoin the needles, the engine failed again. The aircraft struck the ground in the ditched sod between the north and south lanes of the highway. It hit tail first shearing the tail wheel. The left gear struck the bottom of the ditch and the left tire blew out. The aircraft continued through the ditch, shearing the right gear and rolling slowly over on its right side. Fire broke out at impact and the aircraft burned. Three passengers were killed in the fire. The other passengers and crew were all burned in varying degrees. The crewchief and one other passenger died later from burn injuries.

Pilot faced almost impossible choice because of heavy traffic on both lanes of divided highway. Arrows show impact point.

Here are excerpts from the pilot's statement:

"When the front wheels touched, it was hard, but it was not a jarring contact. We rolled to the right and slid to a stop.

". . . I unfastened my seat belt. The copilot fell on top of me when he unfastened his belt. I stood up and went to his open window, which was on top. It was in flames and there was a wall of flame between the cockpit and the cargo compartment. The copilot and I kicked at the far right windshield panel, which was next to the ground. The copilot had kicked a small hole in it, which I looked out, but it was too small to get out.

"I removed my helmet to talk to the copilot. We had decided that we wouldn't be able to get out in time when a civilian came up outside. He kicked the remainder of the panel out and I went down to it. The civilian pulled and the copilot pushed, getting me out. We then pulled the copilot out. His clothes appeared to be smoking, so he rolled down the hill to a stream. The civilian yelled that there was someone else in there and tried to get him out in time. We got him out, but he was burning. We put out his fire. The crewchief ran around the helicopter on fire and rolled down the hill.

". . . I looked at the rest of the helicopter, and it was entirely on fire. There was no way for anyone else to get out.

"I thought then that we were the only four who got out, but someone said a lot of the others had gotten out."

Based on verbal statements from the surviving passengers, the following sequence took place in the passenger compartment during the crash. All ten passengers were seated with their seat belts fastened when the engine failed

and the helicopter began a fast descent. Several passengers saw black smoke coming from the exhaust and smelled a strange odor like battery acid or rubber burning. Prior to impact, one passenger definitely released his seat belt, and it was considered possible that another had also released his. The passenger who had released his seat belt was thrown at impact. When the aircraft stopped, smoke and flames were seen at the front of the passenger compartment. One of the passengers broke open a window with a wooden 2″ x 4″ camera mount. Seven passengers exited through this window. One passenger ran into the tail section and would not come out. He was killed in the fire.

Some of the survivors were wearing gloves at the time of the crash. None of these sustained hand burns. Others not wearing gloves were severely burned during their escape. This point was emphasized by the flight surgeon member of the accident investigation board.

Engine and fuel samples were shipped to a laboratory for analysis. Here are excerpts from the tear-down analysis report:

"The skirts of all cylinders were nicked, bent, and torn.

"The exterior surface of all cylinders was damaged by fire.

"The portion of the accessory section that was not destroyed by fire was removed and disassembled. The impeller shaft oil seal rings were in good condition, with no indication of oil leakage in the oil seal ring area.

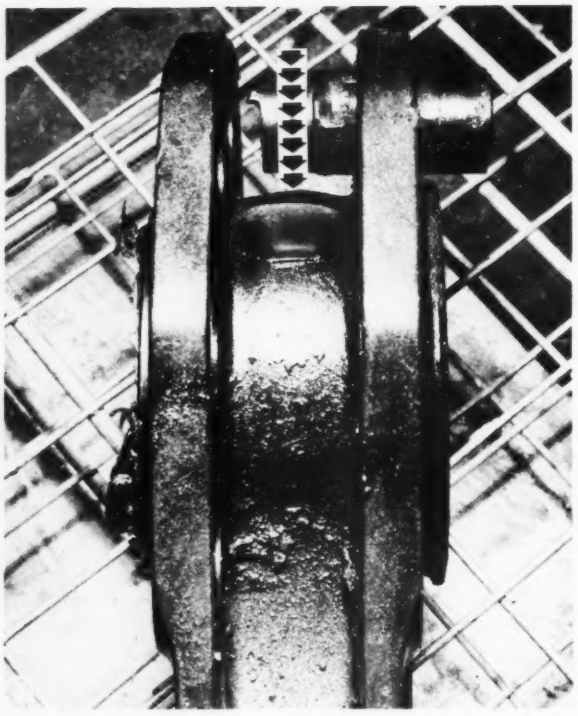
"The impeller was completely destroyed by fire.

"Examination of the accessory drive and starter shaft revealed no indication of twisting or breakage.

"The 3° roller clutch mechanism cam and rollers were not received with the engine. They apparently were lost when a portion of the left side of the engine accessory case was destroyed by fire.

"The carburetor was removed from the engine but it could not be flow tested because of fire damage. The vapor vent return system was checked and found to be in satisfactory operating condition. When the carburetor was dis-

Aircraft was completely destroyed by fire



Bulge between link rod attaching flanges caused link rods to strike master rod

assembled and inspected, approximately two teaspoons of a gelatinous substance was found on the carburetor inlet screen. An effort was made to identify the substance, but it was not possible because of the sample size.

"The B nut on the vapor vent return line was loose at the quick disconnect fitting on the quick disconnect panel.

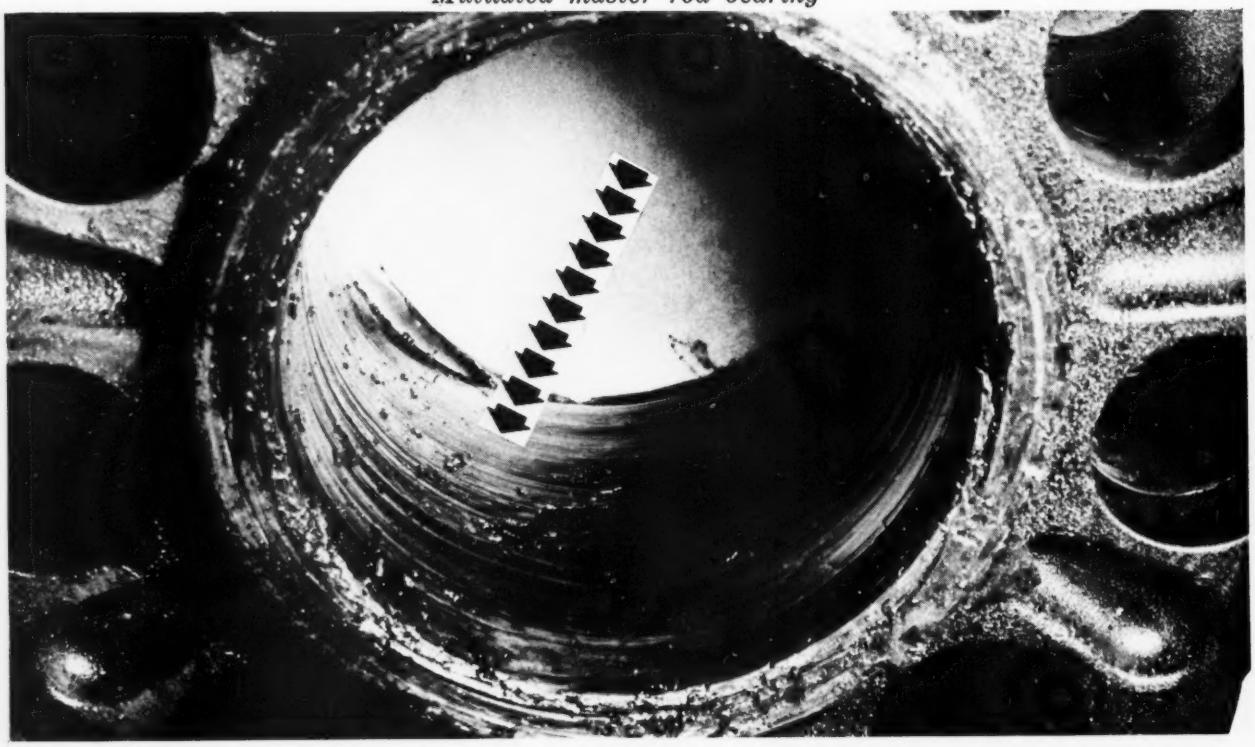
"The fuel pump was removed from the engine, but it could not be bench tested because of fire damage. It was disassembled and found to be in satisfactory condition, except for fire damage.

"A sample of fuel received with the engine and a small sample of fuel taken from the carburetor at the time of disassembly were analyzed and found to contain minute particles of rust and other foreign matter in water. Efforts to identify the source of water were unsuccessful because of the size of the sample.

"The oil pump was removed from the engine and disassembled. Examination revealed no discrepancies and no damage caused by foreign matter.

"The magneto was removed from the engine and bench tested for approximately three hours

Mutilated master rod bearing



with no indications of malfunction.

"The domes of all pistons were damaged by contact with the valves. Close examination of the piston domes indicated that contact with the exhaust valves had occurred at some time prior to the crash. There were also indications on the piston domes that they had been struck by the intake valves, probably caused by overspeed resulting from severance of the main drive shaft when the aircraft hit the ground.

"No. 4 link rod was broken loose from the master rod at a point approximately two and a half inches above the knuckle pin bore.

"No. 5 link rod was broken loose from the master rod at the knuckle pin strap.

"The master rod was bulged between the link rod attaching flanges. The bulge caused the no. 4 and no. 5 link rods to strike the master rod.

"The master rod bearing was mutilated. A portion of the steel shell of the master rod bearing was analyzed to attempt to identify the bearing by part number. While the bearing could not be positively identified by part number, it was definitely determined that it was *not* the correct bearing, P/N 146774 or 147846.

"The master rod bearing oil seal disk was the obsolete type, P/N 171511.

"The knuckle pin locking plate was mutilated and could not be positively identified by part number. Comparison of the remaining portion of the locking plate to the specifications indicates the locking plate in this engine was probably P/N 171512. The correct locking plate number is 147848.

"The crankshaft counterweights were nicked by contact with foreign objects.

"The interior of the crankcase main section was nicked and damaged by contact with foreign objects.

"The crankpin of the crankshaft assembly was severely galled. The lower side of the crankpin was melted by the intense heat generated by friction between the crankpin and the master rod bearing.

"The rear blade of the crankshaft had punch marks at the counterweight bushing location; however, inspection revealed no crack propagation from the punch marks.

"No other abnormalities were noted during disassembly. There were no unauthorized parts

Crankpin of crankshaft. Note melted area.

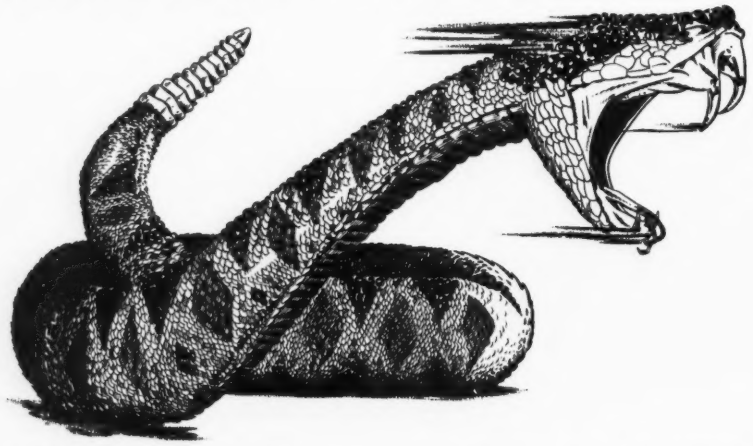
Piston face shows marks caused by contact with valves. Absence of carbon indicates contact with intake valve was most recent.

other than those cited found in the engine. All applicable overhaul changes were complied with.

SUMMARY

"The interior of the power section of the engine was heavily damaged by pieces of the failed connecting rods that broke because of the severe heat and friction generated by failure of the master rod bearing. Extensive damage to the exterior of the engine was caused by fire following the crash of the aircraft.

"*Failure of the engine was primarily caused by master rod bearing failure,* which resulted in excessive heat and friction at the crankshaft crankpin. The master rod partially collapsed, causing it to bulge between the link rod attaching flanges, resulting in contact of the link rod knuckle pin strap with the master rod. The contact caused the no. 5 link rod to break at the strap and the no. 4 link rod to break just above the strap. The use of the obsolete type master rod oil seal disk was probably a contributing factor to the failure of the master rod bearing; however, experience indicates that the failure was probably caused by failure to preoil or correctly preoil this engine following an extended period of inoperation. From inspection performed on the carburetor and fuel pump, it is not believed that fuel contamination was a contributing factor to the failure or loss of power of the engine. Loss of power was caused by failure of no. 4 and no. 5 cylinders to develop power when the link rods failed."



FROM *Aerobits,* AEROSPACE SAFETY, USAF, December 1963 — "The Snake Pit":

"Shortly before penetration at Luke in his F-100, the pilot experienced a hot cockpit condition. During his penetration, cockpit hot, he felt what he thought was a grasshopper lodged under his helmet between his ear and the earphone pad. While attempting to continue his instrument approach and dislodge the unknown intruder he saw a snake, variety undetermined, crawl across his legs and disappear from view under his right leg. Somehow, in the words of the report, 'through superior skill and cunning while he tried to dislodge an insect, cool the cockpit, and expect a snake bite at any moment, the remainder of the approach and the landing were relatively normal.'

"The hot cockpit was caused by failure of the cooling turbine. The resultant heat evidently caused the unusual amount of movement by the uninvited inhabitants. The snake was apparently transported to the aircraft in the pilot's helmet bag, which had been left for several hours in the squadron area at his Florida base of departure. What the pilot thought to be the grasshopper in his earphone area could very well have been the snake, whose length was estimated at 15 inches. Presence of the snake was confirmed by maintenance personnel who briefly saw it, but were unable to capture, kill, or identify it. Insect and rodent control completely fumigated the aircraft and the canopy was left closed for two days. An entomologist from Arizona State University asserted that the snake could not have lived through two days of such intense heat as the closed canopy would cause. The seat was then removed for further search — negative results. The seat was replaced and the pilot finally agreed to complete his ferry mission.

"It is recommended that pilots flying through or stationed at high insect, rodent, or reptile infested areas be especially cautious as to disposition of personal equipment during times of delay or RON. Always keep helmet bag zipped."

Crash number one — nonsurvivable

Crash Resistant Fuel Tanks Tested for . . .

Helicopter Fire Prevention

Major Joseph A. Gappa, Jr., and Captain Robert W. Newton

FIRE IS the biggest killer in Army helicopter accidents. USABAAR studies covering the period July 1957 - June 1963 show that while fires were involved in only 8 percent of all major helicopter accidents, they accounted for 62 percent of the total fatalities during this period. These studies also show that fire accidents accounted for 40 percent of the total injured, that 89 percent of all fires start during or after impact, that 70 percent of all fire accidents happen in otherwise survivable accidents, and that the main source of ignition is

Standard tanks after crash

the powerplant. Electrical ignition sources were definitely established in only two accidents during this period.

Though other factors are involved, the problem of helicopter fires has its origin in two items which have more or less dictated the design configuration of our aircraft. These are the center of gravity, which is largely responsible for the location of fuel tanks, and the power available, which dictates the care used in retaining this fuel. Larger helicopters and improved powerplants have lessened the influence of these items in design configuration. Unfortunately, a fair share of this gain in design limitations has not been reinvested in design features to lessen the danger of fires.

The first phase of a two-phase test to design and fabricate crash resistant fuel tanks for OH-13G and H model aircraft was completed by the Bell Helicopter Company in October 1963. During this phase, a number of different types of tanks were statically dropped and compared to standard tanks. From this, two different sets of tanks were selected from the variety of tanks tested. These two sets showed great promise of providing tanks with definitely improved crashworthy characteristics.

One set of tanks is intended for use as a modification of all existing OH-13G and H model aircraft in the Army inventory. These are standard tanks wrapped with layers of continuous weave nylon cloth impregnated with polysulfide rubber. It is expected that this modification can be accomplished at third echelon maintenance when approved and directed. This modification would apply to 331 H model and 169 G model aircraft.

The second set of tanks is intended for use on production type aircraft (OH-13S) and for retrofit of OH-13S aircraft with the old type tanks. This set is nonmetallic, constructed from layers of nylon cloth impregnated with FM-1000 epoxy resin. This shell is covered with several layers of fiberglas, and a polyurethane bladder is installed in the shell.

The second phase of the test was conducted by USABAAR engineering personnel with three category B, OH-13D aircraft. One aircraft was equipped with standard tanks, one with wrapped tanks, and one with nonmetallic tanks. The three aircraft were crashed in as near-identical circumstances as was possible, and in a manner that simulated an accident well within survivable human tolerance limits. The three aircraft were repaired to a degree that would permit reasonable assurance of a one-time flight of short duration.

From past accident experience, it was determined that a typical survivable crash in which fire killed the occupants was an accident in which the aircraft rolled or pitched over. To simulate this type accident, the aircraft were placed on the crash site with safety pins across the skids. With the safety pins in place and a loose center tiedown cable, the aircraft were brought to a 1-inch hover and the correct control positions of the cyclic stick and rudder pedals were determined. These two controls were then locked in place and the pitch bottomed. At this time, the center tiedown cable with a remotely operated wire cutting device was attached to the aircraft. This cable was then tightened with a turnbuckle so the aircraft could not move about its yaw axis when a moderate amount of pitch was applied.

Ballast, equal to a pilot's weight, was added to maintain the center of gravity within limits.

Maj Gappa and Capt Newton are with the Engineering Section, United States Army Board for Aviation Accident Research.

Pitch was applied and the throttle was opened to a manifold pressure approximately 4 inches more than that needed to hover. The throttle and collective pitch controls were then locked in place. After all personnel cleared the area, the safety pins were pulled by remote control and the aircraft was held in place by a single tight cable acting approximately through the aircraft c.g. This final cable was cut by remote control.

A simpler method of applying collective pitch was used on the third crash. Signal wire was attached to one of the collective bellcranks so pitch could be applied by pulling on the wire from a remote location. After the pedals and cylic controls were adjusted and locked, the engine was run up to 3200 rpm. The safety pins were removed after all personnel were cleared, and the helicopter was flown by pulling the wire attached to the collective pitch bellcrank.

Two cables were attached to each aircraft to induce the crashes. One cable was attached to the right skid gear and the second, a safety cable, to the aircraft center frame. These cables were 20 and 40 feet in length. The final cable, attached to the center of the front cross beam, had an explosive type cable cutting device. When the center cable was cut, it was planned for the aircraft to rise, hit the end of the 20-foot cable, inducing a roll or pitch, or a combination of both, and be snubbed into the ground.

Salvaged concrete coal bins, modified to serve as bunkers, were used as protection for observers and camera operators. In addition, all personnel wore steel helmets and safety glasses. Eight movie cameras were mounted behind the bunkers in four different locations.

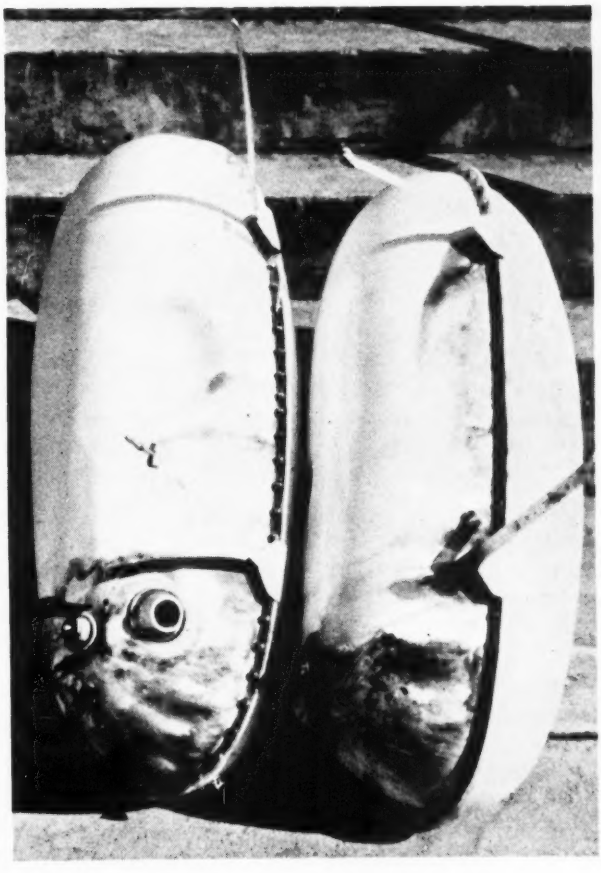
CRASH NUMBER ONE

This aircraft was equipped with standard tanks. After it was released from the ground, the helicopter rose to a height of approximately 8 feet and moved to its left rear for a horizontal distance of 40 feet at about 10 mph before impact. It rolled to its left side and came to rest on its left side after impact. Crash forces were light and entirely within human tolerance limits, but this crash was determined to be nonsurvivable because of the catastrophic fire which developed at impact.

This fire developed with explosive rapidity because of a large cloud or mist of fuel formed by the aircraft dynamic components when the

Crash number two — survivable

Nonmetallic tanks after crash test



Crash number three — survivable

Wrapped tanks after crash test

tanks ruptured and the crossfeed line pulled loose. This happened when the main rotor began striking the ground before the airframe hit. The bottom support of both tanks tore loose, allowing the crossfeed line to be pulled from the tanks. When the main rotor struck the ground, the swash plate and associated moving parts struck one tank, causing it to rupture. The ignition point was the lower left engine exhaust port. Ignition occurred prior to the main impact. By the time all components of the aircraft came to rest, the entire main structure was completely engulfed in flames.

The right tank showed evidence of strikes made by the swash plate and associated moving parts. The left tank received no apparent damage from the crash, but the crossfeed was pulled out of the weld joint, producing a hole 2 inches in diameter.

Light impact forces from this crash were determined by a study of high speed and normal speed 16mm movie film: the fact that the bubble was intact after impact; the undamaged state of the entire rear structure, including the tail rotor; and the lack of structural deformation of the cabin section.

CRASH NUMBER TWO

This aircraft was equipped with nonmetallic tanks and the impact forces were moderately severe. No fire resulted. The aircraft rose about 4 feet and moved in a left front direction for approximately 40 feet at 10 mph. It rolled and impacted on its left side and came to rest in that attitude. This crash was determined to be survivable.

Moderately severe impact forces were determined from a study of the high speed and normal speed 16mm movie film. The cabin section showed no visible structural deformation.

The right tank was damaged when the channel beam in the bottom of the gas shield broke and made a small 1-inch tear in the bottom of the tank. No gas leak developed from this tear. The left tank sustained much more damage than the right tank. The aircraft partially impacted on, skidded, and came to rest on the left tank. Scratch marks on the tank were produced when it made contact with the ground. Two tears, one of 2 inches and one of 3 inches, developed from the crashing action. The 2-inch tear produced no leakage, and the 3-inch tear produced only a slow seepage. The main source of gas leakage was produced after the crash from the vent lines, specifically from the air lock relief holes at the tops of the tanks.

CRASH NUMBER THREE

This aircraft was equipped with wrapped tanks. It made a straight ahead level takeoff as pitch was applied and rose to a height of approximately 100 feet before it came to the end of the 20-foot cable. It then nosed over and crashed, coming to rest partially inverted on the mast and cabin 20 feet from the takeoff point. No fire developed.

Though impact forces were severe, this crash was also determined to be survivable. The cabin area showed no apparent structural deformation. The console tore loose, but moved only rearward. Crew member space, though distorted and deformed, still remained essentially intact. Shoulder harness and seat belts would have been indispensable for survival in this crash.

As in crash number two, the only gas leakage developed from the vent line, specifically from the air lock relief holes.

CONCLUSIONS

Crash Number One:

The right fuel tank was ruptured by the swash plate and associated moving components.

Both tanks were ruptured as the crossfeed fuel line fittings were pulled from the tanks.

Movement of the aircraft and its dynamic components mixed raw fuel with surrounding air and introduced this mixture to the explosive source.

Mounts were inadequate to prevent motion of the fuel tanks relative to the airframe.

Crash resistant tanks with breakaway fuel line fittings probably would have prevented fire which resulted from this crash.

Crash Number Two:

Impact forces dealt the left fuel tank would have ruptured a standard tank.

Impact forces sustained by the right tank probably would have ruptured a standard tank.

The crash resistant tanks used in this crash prevented circumstances leading to a postcrash fire from developing.

Vent line leakage produced a secondary postcrash fire hazard.

Crash Number Three:

Forces sustained by both fuel tanks probably would have ruptured standard tanks.

The crash resistant fuel tanks used in this crash prevented circumstances leading to a postcrash fire from developing.

Vent line leakage produced a secondary postcrash fire hazard.

General:

The energy and behavior of the dynamic system of a helicopter cannot be simulated. This required crash drops with all systems operating. The fire hazard potential of an operating powerplant on crash impact must also be considered in this manner, though to less extent.

An obvious factor in producing a postcrash fire hazard is the mixture of raw fuel with air during the crash. The dynamic systems of the aircraft play major roles in producing the raw fuel (rupturing tanks) and mixing the raw fuel and air (rotor movement, engine fan rotating, and fuel falling through and striking various components of the aircraft in its path of flight) to explosive proportions.

Present fuel tanks are intolerably fragile. They are susceptible to rupture by puncture and impact, and are inadequately restrained by their mounts and retension straps.

Present-day fuel feed lines can be pulled from the OH-13 tank during the process of impact, permitting fuel to flow freely.

Crash resistant fuel tank configuration for all OH-13G, H, and S model helicopters is feasible and the essential elements are available now. These include modified standard tanks, or nonmetallic tanks, as demonstrated in the crash tests; breakaway (self-sealing) fittings to be located at each fuel line, fuel tank juncture point, and at the carburetor fuel line juncture point; improved fuel tank mounts and mounting points to prevent lateral movement of fuel tanks and secondary damage to fuel tanks from mount components; and improved vent lines designed to prevent fuel leakage in abnormal attitudes.

As a result of these tests, it was recommended that ECP action be initiated to modify all OH-13G and H model helicopters with crash resistant fuel tanks and the additional essential elements of a crash resistant fuel system. It was also recommended that ECP action be initiated to retrofit all OH-13S model helicopters with crash resistant fuel tanks and additional essential elements for a crash resistant fuel system. It has been learned that these recommendations are being favorably considered.

Copies of the report from which this article was written are available. The title of this report is *Crash Resistant Fuel Cells, OH-13 Aircraft.* Please address your requests to Director, USABAAR, Fort Rucker, Alabama. Direct communication authorized by AR 15-76.

Continued from page 1

It is easy enough for most Army Aviators, IF THEY WANT TO, to maintain sufficient proficiency in their basic branch while on Category I & II flying assignments through nothing more than just plain old honest endeavor. You know — study, reading professional publications, developing an interest, trying to get ahead, etc. This, plus his branch service schools and ground tour assignments are sufficient to make him a branch qualified officer. Again, let's be realistic; during hostilities the Army Aviator is going to be in an aircraft anyway. There is a shortage of pilots now, there is going to continue to be a shortage of pilots, and a war isn't going to improve the situation any. Take Vietnam for instance.

There are far too many pilots who just want to fly an airplane and be done with it, which to the experienced pilot is a pretty easy way to make a living . . . . These are the people who do the majority of the complaining about having to maintain branch qualification. It comes under the heading of work, brother.

Having completed an eighteen months ground tour assignment, I can say that it was no problem to my flying career, simply because I wasn't required by regulations to maintain my former flying proficiency . . . . Aviation commanders that I have known are acutely aware of, sympathetic to, and will allow for the flying shortcomings of a pilot on or just off ground duty. And, a pilot through daily flying can regain his flying proficiency in a matter of weeks or very few months, depending on his past flying experience. The same applies to someone trying to bring his knowledge of the technical aspects of his branch of service up to par. All that is necessary is for him to recognize his shortcomings, know his limitations, study, and APPLY himself. I personally found the ground tour assignment most rewarding and stimulating and looked upon it as a very broadening experience.

I again submit that the problem which exists in this area of ground and air duties is inversely proportional to the willingness of the OFFICER to do a job. Any experienced pilot who is content to do nothing but fly, particularly the type of aircraft the Army has, is, as grandmother used to say, "not much to have around the house." I would like to point out one final thing: Army officers were not selected for pilot training because of their shortcomings. The Army premise that an average rated officer can be both a good pilot and good ground officer throughout a career is VALID. He can if he wants to be. I know a lot of them.

CAPTAIN STEPHEN FARISH
26th Trans Company (Lt Hel)
APO 44, N. Y., N. Y.

Sir:

1. We note on page 38 of the January '64 issue of your DIGEST that a recent case of incorrect assembly of the ailerons on a Beaver aircraft has been experienced.

2. On the Beaver aircraft used by the British Army an extensive modification is currently in progress to eliminate the possibility of physically crossing controls. The aileron control circuits were omitted from this programme since no possibility of malassembly was seen except for the remote possibility during major servicing of installing the control column chain incorrectly. The modification applicable to this feature is merely a warning label to draw attention that the turnbuckle must be on the RH side of the column looking forward.

3. Your report has now thrown doubt in this decision and we would be grateful if you will forward details of the defect which produced the occurrence in para 1 above. This will enable us to review the need for including the aileron control circuits in our current modification programme.

4. May we take this opportunity to say how we enjoy reading your digest, both for its engineering instructional value and its general information on military aviational matters.

JH TOMKIN, MAJOR
for Brigadier, Army Air Corps
Middle Wallop, England

Sir:

* * *

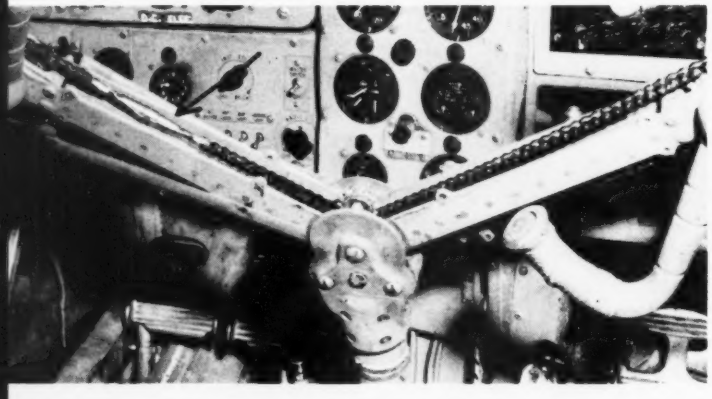
We have on record two cases in which reverse rigging of aileron controls caused major accidents in Beaver aircraft. As you correctly diagnosed the situation, both accidents were caused by reverse installation of the control column chain where the turnbuckles were found on the left side of the control column looking forward. A recommendation made as a result of the second accident of this type was that the turnbuckle on the control chain be color coded with a corresponding section of the control yoke to draw attention if it is incorrectly installed. However, your modification of a warning label would appear to be an equally successful solution.

We would certainly appreciate the details of your modification to eliminate the possibility of physically crossing controls. This is of great interest to us as we are currently establishing design criteria for future aircraft.

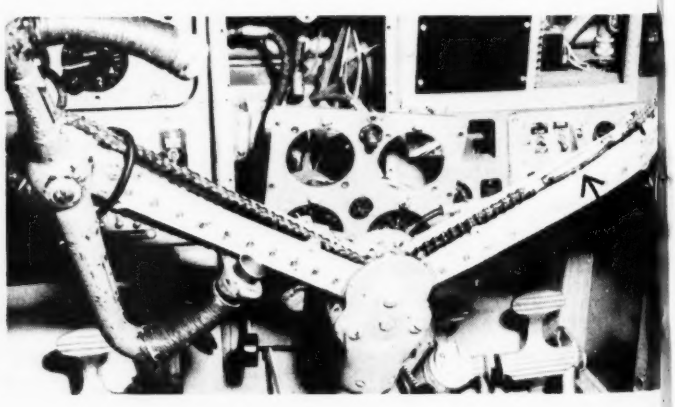
* * *

COL ROBERT M. HAMILTON
Director, USABAAR

Control chain rigged backward



Properly rigged control chain



Airfield Checkout

POTENTIAL emergency landing areas for aircraft may now be located from the air by a novel method of measuring soil hardness. A research program conducted by New York University has resulted in the development of a one-pound rocket projectile, called a penetrometer, which can be fired earthward from mechanisms installed in modified wingtip fuel tanks of aircraft. If the impact (measured by a deceleration switch) is greater than

a preset level, an infrared bulb in the tail of the penetrometer lights up. Thus each individual penetrometer measures the weight that the soil will bear as determined by the present level. Review of aerial infrared photography of the penetrometer's impact area will eliminate unsuitable areas and identify the most promising locations. — U.S. Air Force release. Reprinted from "Military Notes," MILITARY REVIEW.

Survival Axe Available

THE ARMY recently contracted to purchase the survival axe pictured above. It has proved to be an outstanding tool for work in brush, briars, or when chopping close to the ground. Helicopter crewchiefs will find it useful in preparing landing sites. The kit, which contains a sharpener and burning lens, is available through normal supply channels. Its nomenclature is Survival Axe 784, MIL-S-8642C-Type 4.

21 SKID-DOO

TOTAL ENGINE failure! Never a pleasant situation, this is even worse when it occurs while flying over the rice paddies of the Republic of Vietnam.

Recently a CH-21 pilot was confronted with just such a problem. He started an autorotation to a road, but landed short in a rice paddy containing 2½ feet of water. It was imperative to get the aircraft out of the rice paddy before dark when it would become easy prey for the Viet Cong.

A group of Vietnamese engineers arrived just before noon to move the aircraft onto the road. How did they do it? They simply . . . 1) jacked up the aircraft and 2) built a "raft" under it. 3) Then they extended the "raft" toward the road. 4) Engineers moved the CH-21 on three steel I-beams and built onto the forward edge of the "raft" with wooden beams that had served their purpose on the aft edge. 5) Once near the edge of the rice paddy, they pushed the CH-21 onto the road, 6) then hooked it to a truck and towed it away — long before dark.